CERTIFICATE OF ADOPTION
MARCH 12, 2019
TOWN OF WARREN, VERMONT SELECTBOARD
A RESOLUTION ADOPTING THE TOWN OF WARREN, VERMONT 2018 LOCAL HAZARD MITIGATION PLAN

WHEREAS, the Town of Warren has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of the hazards profiled in the Town of Warren, Vermont 2019 Local Hazard Mitigation Plan, which result in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Town of Warren has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its 2019 Local Hazard Mitigation Plan (Plan) under the requirements of 44 CFR 201.6; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies, and Plan maintenance procedures for the Town of Warren; and

WHEREAS, the Plan recommends several hazard mitigation actions (projects) that will provide mitigation for specific natural hazards that impact the Town of Warren with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make the Town of Warren eligible for funding to alleviate the impacts of future hazards;

WHEREAS, a duly-noticed public meeting was held by the Town of Warren Select Board on March 12, 2019 to formally adopt the Warren Local Hazard Mitigation Plan; now therefore be it

RESOLVED by Town of Warren Selectboard:

1. The Town of Warren, Vermont 2019 Local Hazard Mitigation Plan is hereby adopted as an official plan of the Town of Warren;

2. The respective officials identified in the mitigation action plan of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them as town capacity and funding allows;

3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as part of this resolution for a period of five (5) years from the date of Formal FEMA approval of the Plan; and

4. An annual report on the process of the implementation elements of the Plan will be presented to the Selectboard by the Local Mitigation Planning Committee.

IN WITNESS WHEREOF, the undersigned have affixed their signature and the corporate seal of the Town of Warren this __12__ day of _March_, 2019.

Andrew Cunningham, Selectboard Chair

Bob Ackland, Selectboard Vice-Chair

Luke Youmell, Member of Selectboard

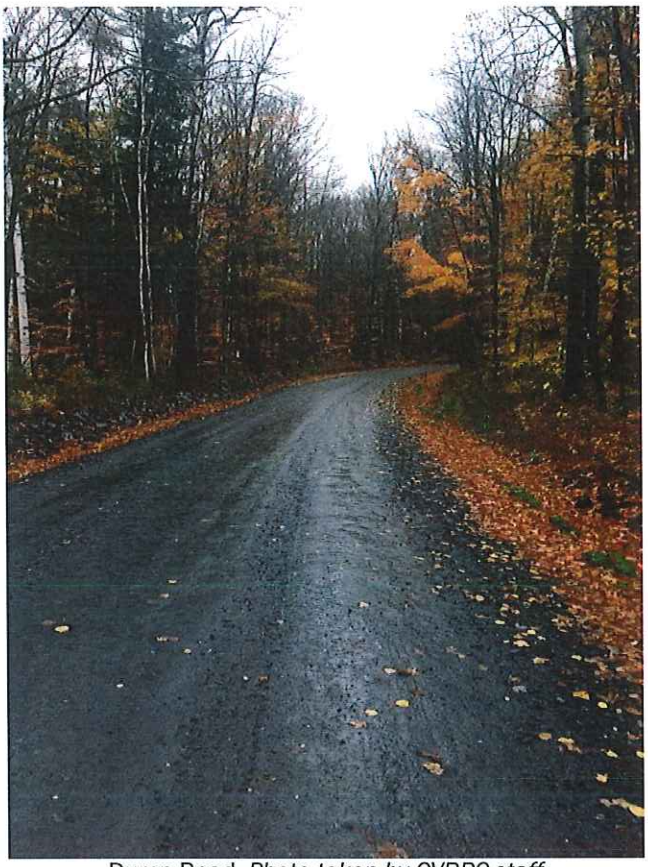
Randy Graves, Member of Selectboard

Mary-Ellen Alberti, Member of Selectboard

ATTEST

Reta Goss, Town Clerk

Town of Warren
Road Erosion Inventory Report



Dump Road. *Photo taken by CVRPC staff*

Prepared by:

CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION

29 Main Street, Suite 4
Montpelier, VT 05602

Date: 11/21/18

Inventory and report funded by the Vermont Agency of Transportation 2017 Better Roads Program.

Report templet created by Two Rivers-Ottauquechee Regional Commission and used with permission by the Central Vermont Regional Planning Commission.

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Appendices

Introduction

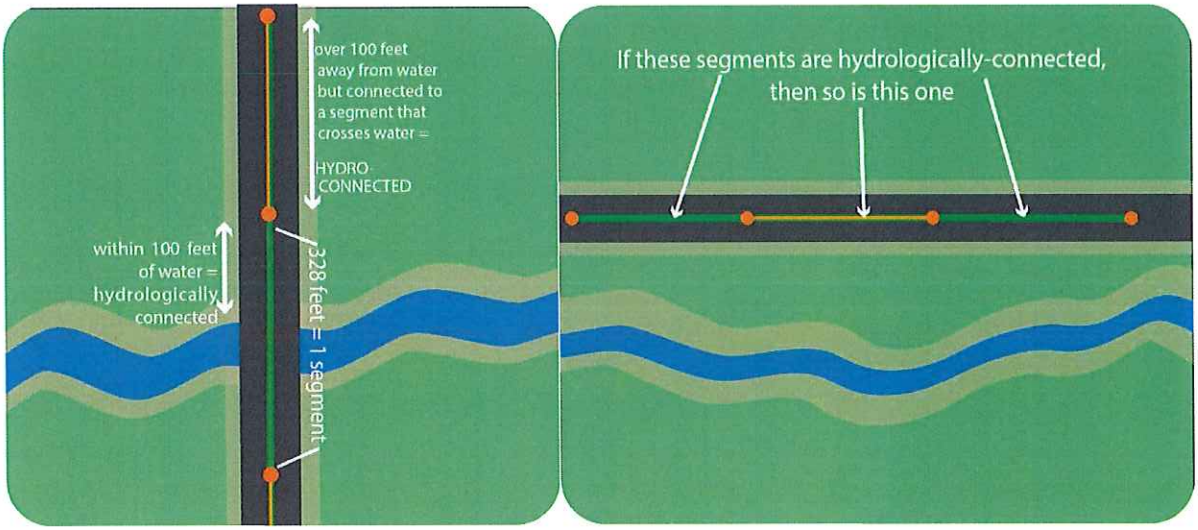
In the spring and summer of 2017, the Central Vermont Regional Planning Commission (CVRPC) conducted a road erosion inventory (REI) to evaluate hydrologically connected segments in the town of Warren. This report highlights the road sites with the most significant hydrological impact due to erosion within the municipality.

Hydrologically-connected road segments are one or more of the following:

- Within 100' or within river corridor layer to water resources (perennial and intermittent streams, wetlands, lakes and ponds)
- Road segments that bisect a water resource
- Adjacent segments to bisected connected segments if 8% or greater slope
- Road segments that bisect 24" or greater culverts
- Non-connected segments that were bordered on either side by a connected segment
- Stormwater infrastructure mapping

*There may be additional factors when assessing urban areas

The following diagrams depict the criteria for ***hydrologically-connected road segment:***



Images created by TRORC staff

Background

Problem Definition

Many roads in Vermont traverse waterways since these are the lowest and flattest parts of the topography. Erosion, exacerbated by unpaved roads, has adverse effects on nearby bodies of water. During rain events road sediment is deposited directly into the water resources. Water resources are defined as perennial and intermittent streams, wetlands, lakes, and ponds. Road sediment in water resources causes a wide spectrum of ecological

problems including increased algae blooms and decreased levels of dissolved oxygen, both of which negatively impact fish habitat and the ecosystem as a whole.

Response
Solutions are taking shape in the form of state permits and grants. Grants will support proper construction and maintenance of road drainage and surfaces, while the permit will set a standard with criteria that must be met. The goal is to minimize road erosion caused by storm runoff and ensure that any sediment that does erode is sufficiently diverted and filtered before reaching the watershed.

Implementation
Instrumental to both grant funding and permit compliance is the Road Erosion Inventory (REI), and Evaluation. The purpose of the inventory is to identify locations that result in problematic road erosion. These are the places that require continuous attention by town road crews to maintain quality or restore problems. Since sediment only reaches the watershed if the road is close to open water (rivers, streams, lakes, ponds, wetlands), only hydrologically-connected road segments were assessed.

The Department of Environmental Conservation (DEC) provides GIS data of these hydrologically-connected road segments for each municipality. The inventory reflects the criteria set out by DEC's drafted Municipal Roads General Permit (MRGP), which is based on the Better Roads Manual provided by the Vermont Agency of Transportation (VTrans).

The MRGP draft indicates that:

1. By July 2018— Municipalities apply for MRGP coverage and pay fees. (Starting in 2018, municipalities will be required to submit MRGP compliance updates once per year.)
2. By fall of 2020— Municipalities are required to submit a Road Stormwater Management Plan (RSWMP), which includes road erosion inventories and the implementation plans and schedules.
3. By December 31, 2037— All hydrologically-connected segments are expected to meet MRGP standards.

The MRGP is required by the Vermont Clean Water Act (Act 64), and the Lake Champlain Phase I TMDL; the permit is effective as of January 26, 2018. While funding from DEC might be available through the Ecosystem Restoration grant program, towns currently apply for funding through VTrans Better Roads grants. Better Roads is funded with state funds that could include appropriations through the Transportation Bill, the Clean Water Fund and the Capital Bill as well as federal funding VTrans receives from the Federal Highway Administration.

Methodology

- The DEC determined all hydrologically-connected municipal roads (paved, gravel, and class 4) based on proximity to water.
- The hydrologically-connected roads were divided into approximately 300 foot segments and given an identification number.

- Each segment was assessed and given a score of Fully Meets, Partially Meets, or Does Not Meet for the crown, berm, drainage, conveyance, drainage culverts and driveway culverts in the right-of-way. An overall score was given to each segment.
    - Fully Meets (FM) indicates that all individual scores fully met.
    - Partially Meets (PM) designates one or two partially meet individual scores.
    - Does Not Meet (DNM) stipulates three or more partially meets individual scores or one or more does not meet individual score.
    - Class 4 roads are evaluated based on gully erosion. If gully erosion is present, the overall segment does not meet. If gully erosion is absent, the overall segment fully meets.

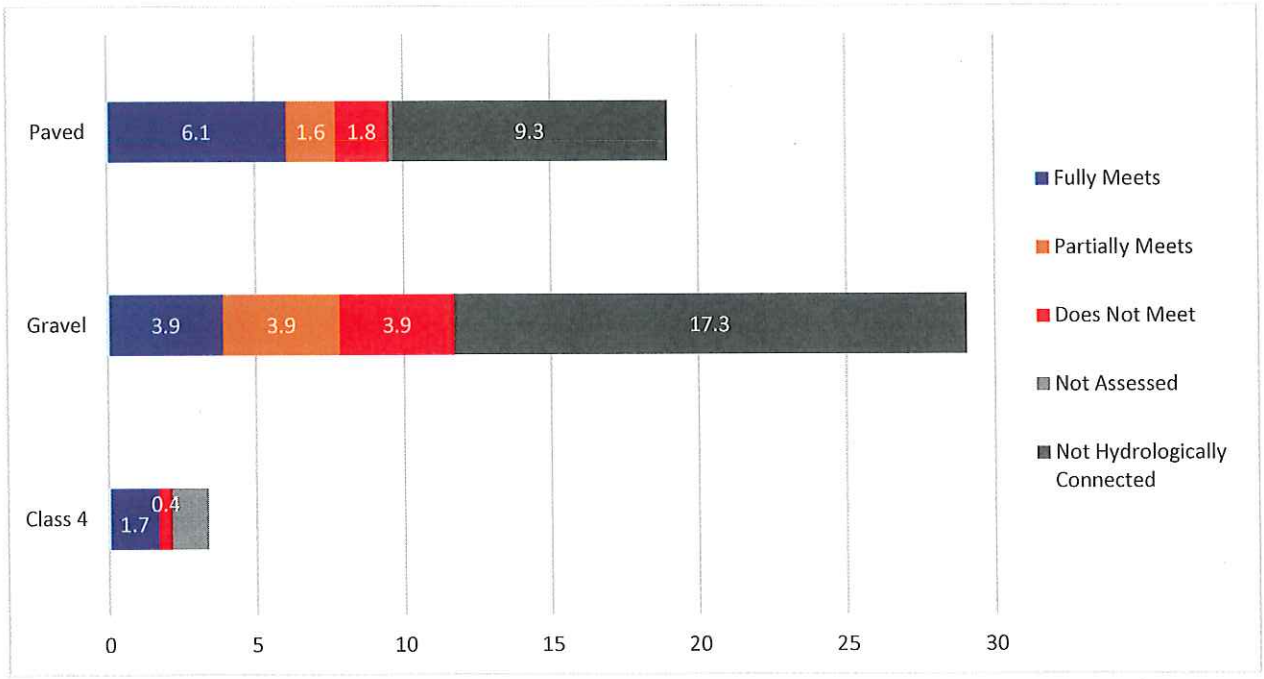
Town Report

Context

The town of Warren is almost 40 square miles of mountains and rivers. The majority of the roads run along rivers and cross them many times. Roads typically are flanked by a steep grade to one side and a river or creek on the other. This combined with steep roads creates extra challenges and emphasizes the importance of proper road drainage installation and maintenance.

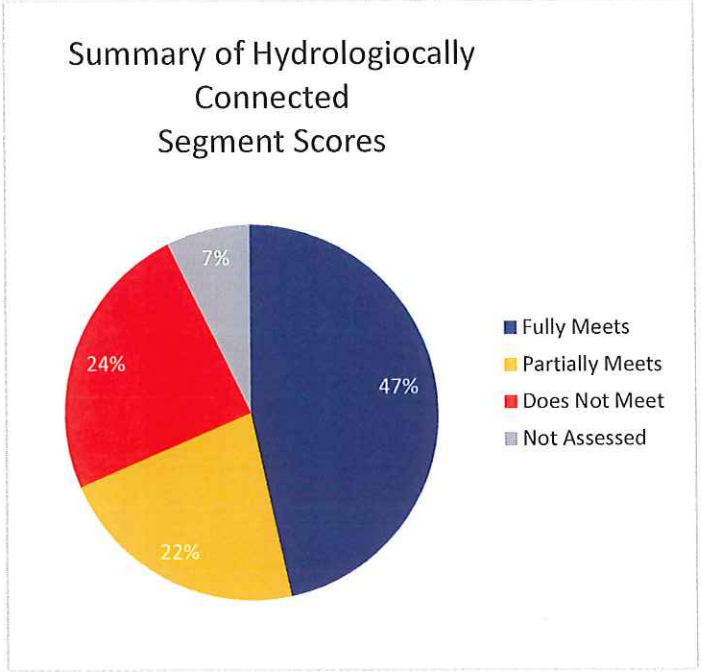
Current Condition

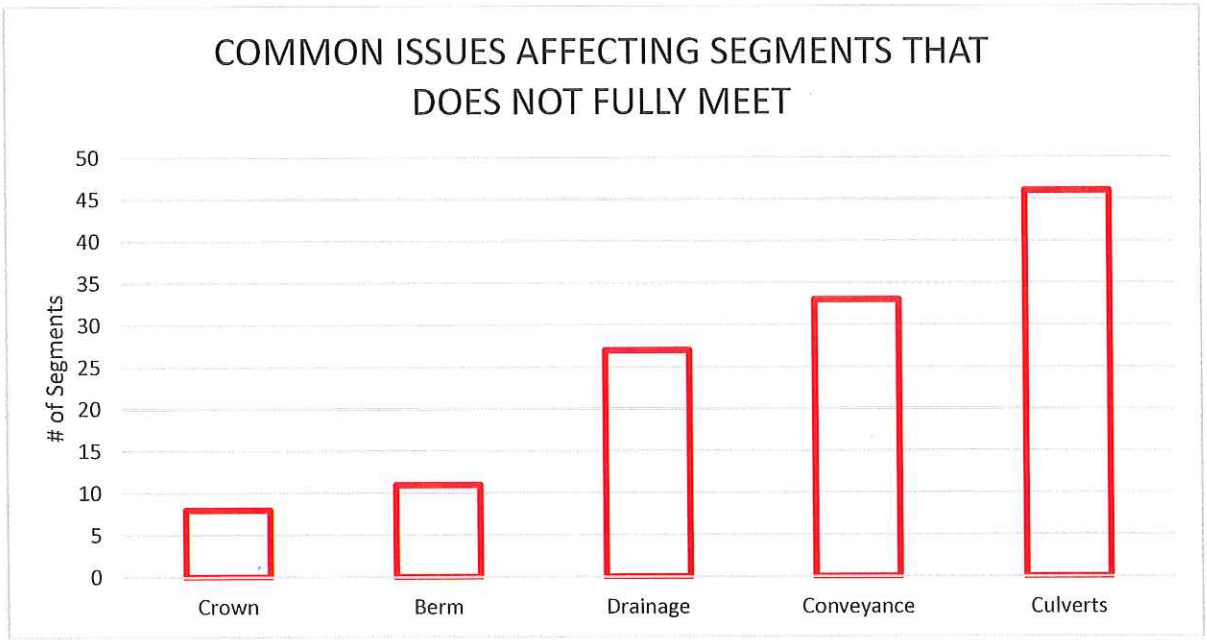
This bar chart depicts the scoring breakdown by road type for hydrologically-connected road miles within the town's total road miles.



Appendix A depicts the town with detailed results of the inventory. The following provides a brief summary:

- There are 410 hydrologically-connected road segments in Warren, or 25.5 miles (including class 4 roads).
- Of these, 46% do not fully meet standards (partially and does not meet); equal 189 segments or 11.7 miles of road.





Thirty (30) segments have been identified as a **Very High Priority**. Very High Priority indicates an overall score of Does Not Meet with a slope of 10% or greater. These are the segments which the town will need to focus on addressing in the first five years of the permit from 2020-2025. They are also a good example of issues facing the road network as a whole as other segments are likely to deteriorate in similar ways.

The three main issues in the very high priority segments are:

- Poor Conveyance (43% Do Not Meet because they are not stabilized and have erosion)
- Poor Drainage (43% Do Not Meet because they are not stabilized and have erosion)
- Culverts (43% Do Not Meet because they have gully erosion)

It is useful to note that of all hydrologically-connected roads, the average road grade is **7%.** This indicates a great need for stone-lined ditches and well-stabilized conveyance areas, as both of these are impacted by the faster flow of water that runs down steep grades.

Common causes for these issues are as follows:

- Inadequate infiltration and diversion practices
- Unstable ditches or no ditches at all where they are needed
- Lack of culvert headwalls, or culverts that are poorly placed, undersized, or in disrepair

Interventions

Very High Priority Road Segments are on slopes >10% that do not meet standards. These must be brought to MRGP standards by 12/31/2025.

For the first permits implementation years of 2021-2022 a minimum of 15% of the non-compliant segments must be upgraded to meet the standards. This equals 28 segments or 1.75 miles of road over this two year period. From 2023 until the permit ends in 2036 (13 years) the town will have to upgrade approximately 12 segments or 0.77 miles per year. These upgrades could coincide with other scheduled maintenance and improvements that the town is planning.

For these the following practices must be implemented:

- >10%: Stone-line ditch with 12" minus stone
- 18" drainage culvert minimum
- 15" drive culvert

For all other segments, best practices for drainage are as follows:

- 0-5%: Grass-lined ditch
- 5-8%:
    - Stone-lined ditch with 6"-8" minus stone
    - Grass-lined ditch with stone check dam
    - Grass-lined ditch AND 2+ cross culverts
- 8-10%: Stone-line ditch with 6-8" minus stone

Conclusion

While the placement of roads in proximity to water poses a threat, adequate road maintenance practices will greatly diminish the rate of unfiltered runoff reaching our valuable natural resources.

CVRPC and your road foremen can coordinate site visits to identify best management practices (BMPs) for remediation. Implementation plans to bring segments to MRGP compliance standards will include measures like grass and stone-lined drainage ditches,

stone check-dams, sheet flow infiltration, ditches and turnouts disconnected from surface waters, road crowning, upgrading culverts, installing outlet stabilization headwalls, and stabilizing exposed soil. This work can help prepares the town for upcoming round of VTrans Better Roads Grants.

Appendix A

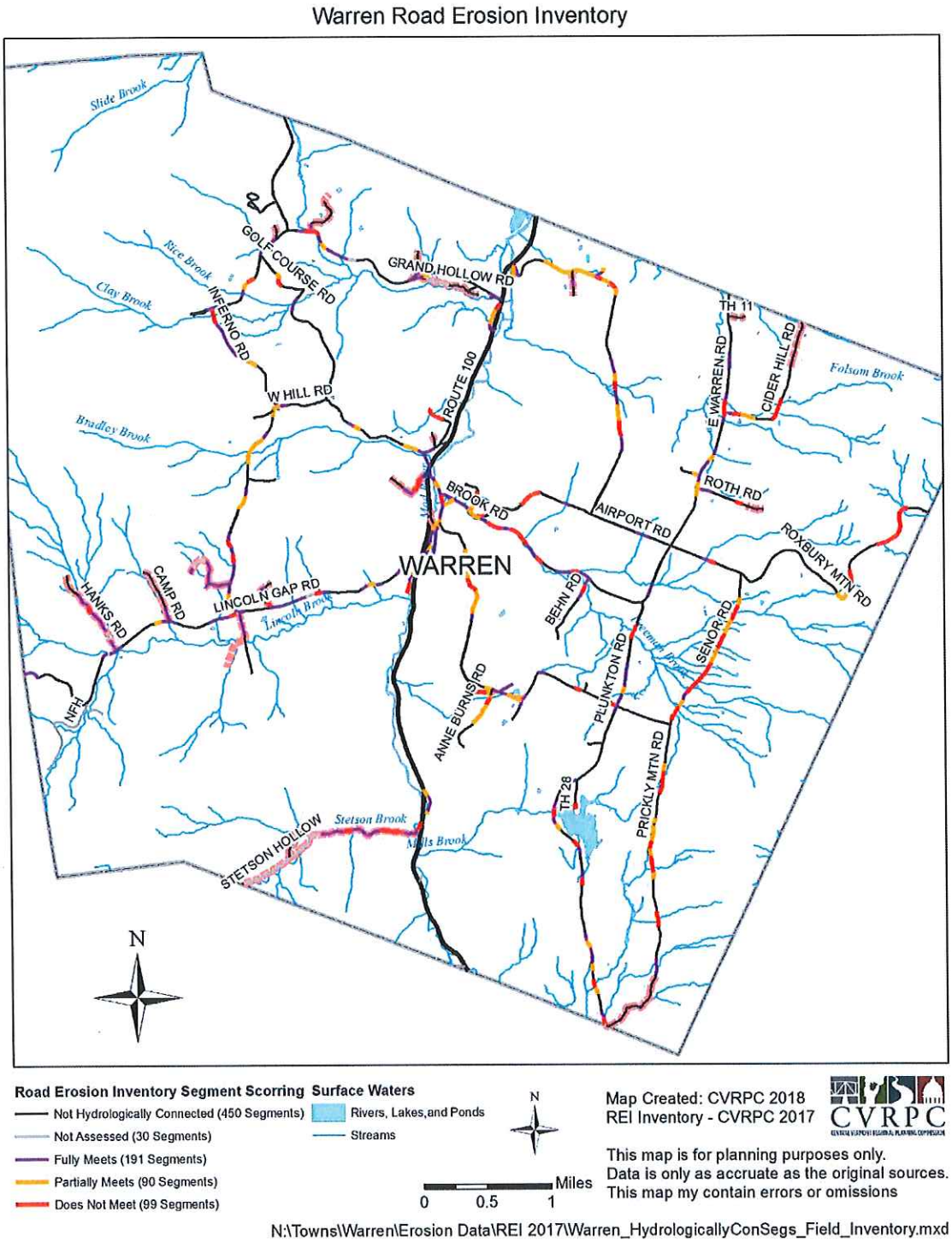


Figure 1- Depicts the Town with all hydro-connected segments and their scores, as well as the breakdown of how many segments Fully Meet, Partially Meet, and Do Not Meet.

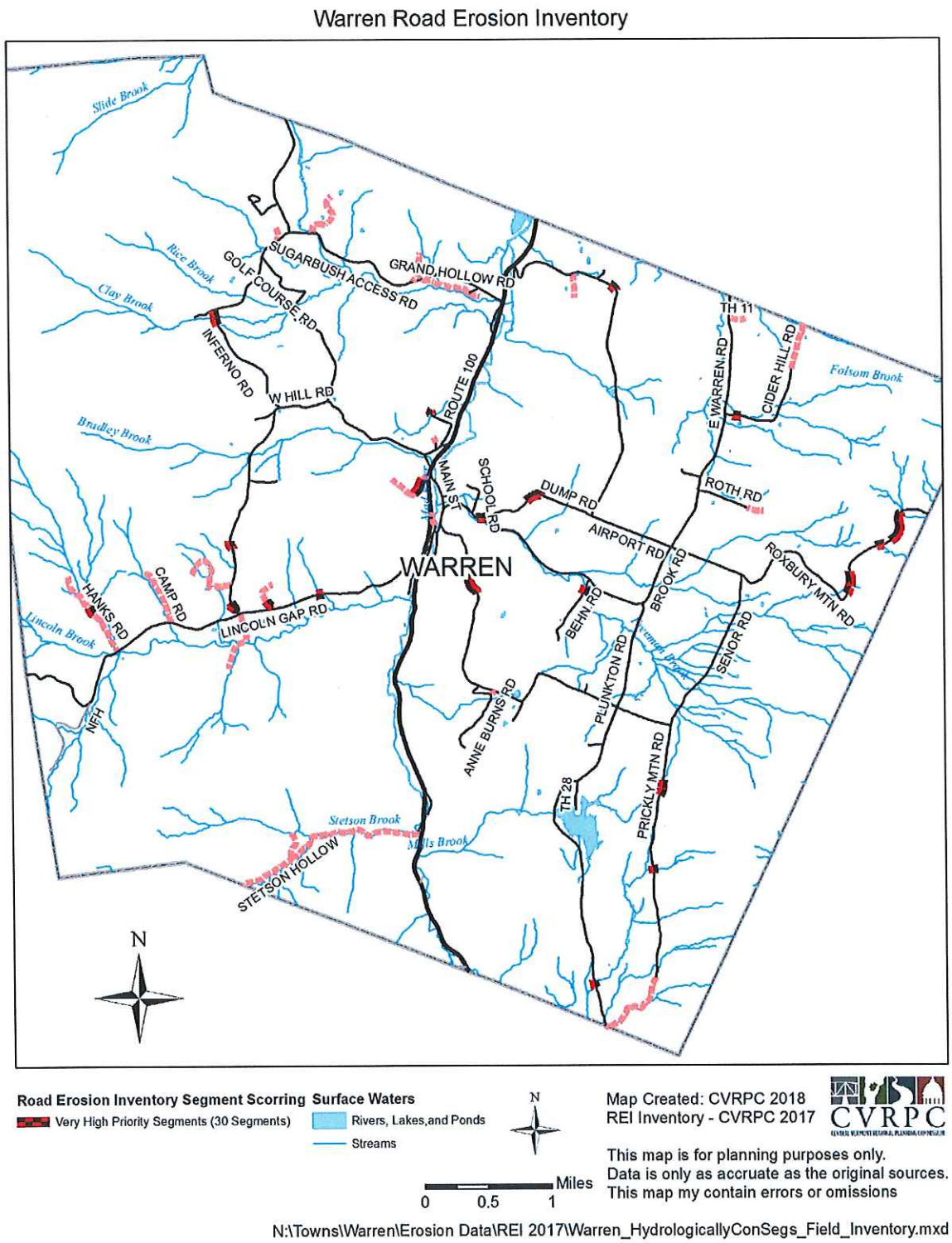


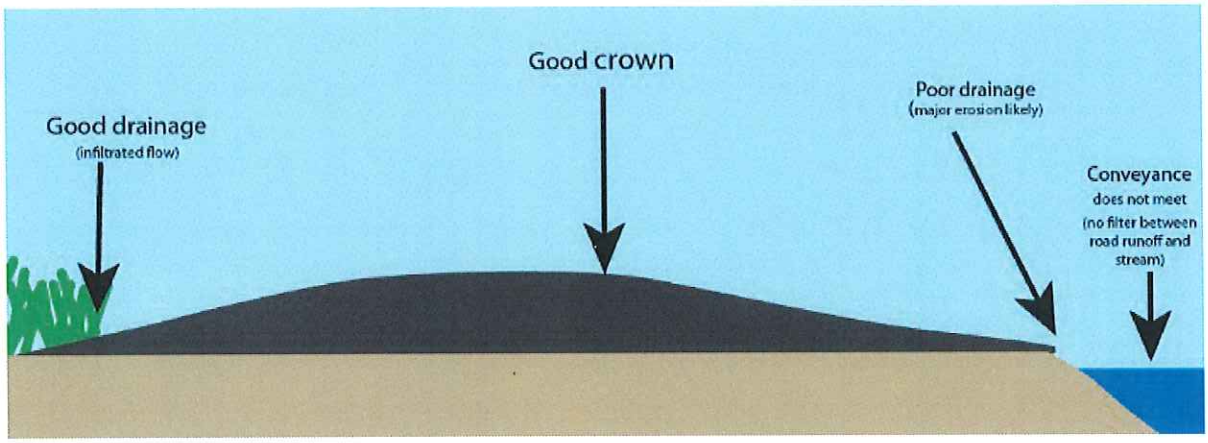
Figure 2- Displays very high priority segments within the Town.

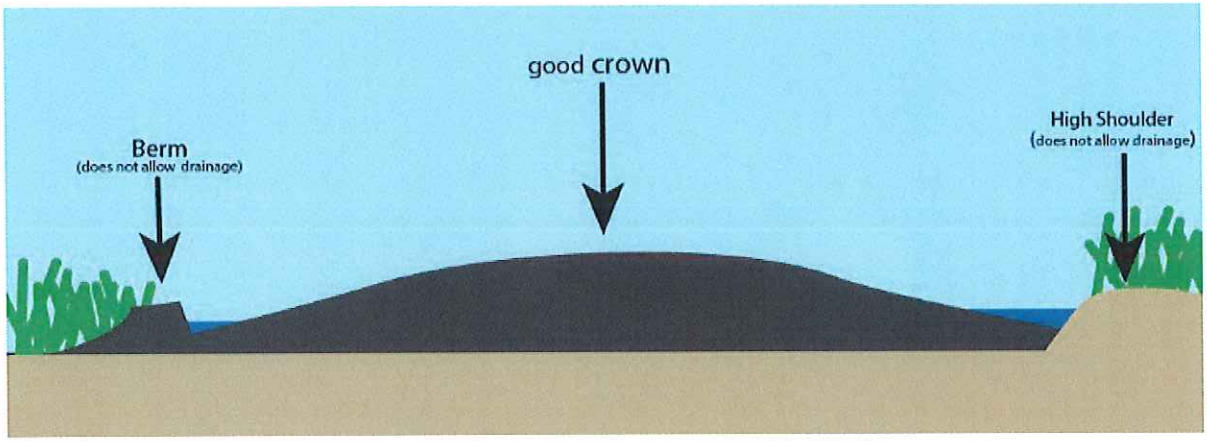
Road Name	Low	Medium	High	Very High - First 5 Years	Grand Total	Road Miles	Possible Year
AIRPORT RD		4	12	1	17	1.06	
ANNE BURNS RD		7			7	0.43	
APPLEWOOD RD	1				1	0.06	
BEHN RD				1	1	0.06	
BOBBIN MILL RD	1	2			3	0.19	
BROOK RD		8	1		9	0.56	
CHARLIE ASHLEY RD	2				2	0.12	
CIDER HILL RD		5		1	6	0.37	
COCKLEBURR FARM RD		1			1	0.06	
DUMP RD		1			1	0.06	
E WARREN RD		5			5	0.31	
FLAT IRON RD	1	1			2	0.12	
FULLER HILL RD		3	10	2	15	0.93	4
GOLF COURSE RD		2			2	0.12	
HANKS RD				1	1	0.06	
HAZEL BROWN RD	1				1	0.06	
INFERNO RD		2		2	4	0.25	
LINCOLN GAP RD	1	2	1	1	5	0.31	
MAIN ST		4			4	0.25	
MILL RD	1				1	0.06	
PLUNKTON RD		7	4	1	12	0.75	1
POWDERHOUND RD	2	1			3	0.19	
PRICKLY MTN RD		7	4	3	14	0.87	3
ROTH RD		1			1	0.06	
ROXBURY MTN RD			5	8	13	0.81	2
SCHOOL RD	2				2	0.12	
SENOR RD		4	12		16	0.99	
SHEPARD HILL RD	1	1		1	3	0.19	
STETSON HOLLOW	1	4			5	0.31	
SUGARBUSH ACCESS RD	1	6			7	0.43	
TH 28	1				1	0.06	
VAUGHN BROWN RD				2	2	0.12	
VICKERY HILL RD				1	1	0.06	
VOLKSTOWN RD	2				2	0.12	
W HILL RD		7	6	2	15	0.93	5
Grand Total	18	85	55	27	185	11.49	

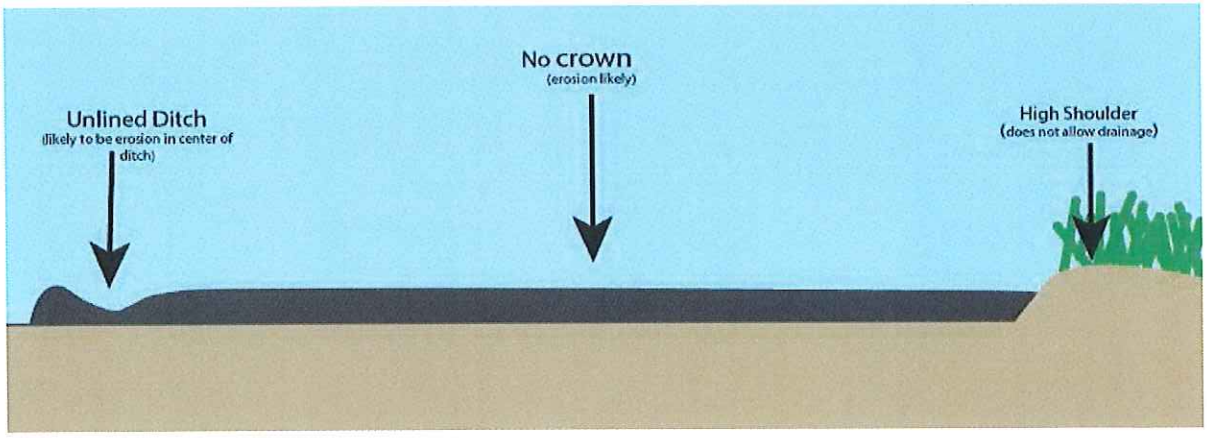
Figure 3- Summarizes all Town roads by priority and recommends a possible year for implementation during the first 5 years of the MRGP.

Appendix B

Table 1 Terminology Illustrated

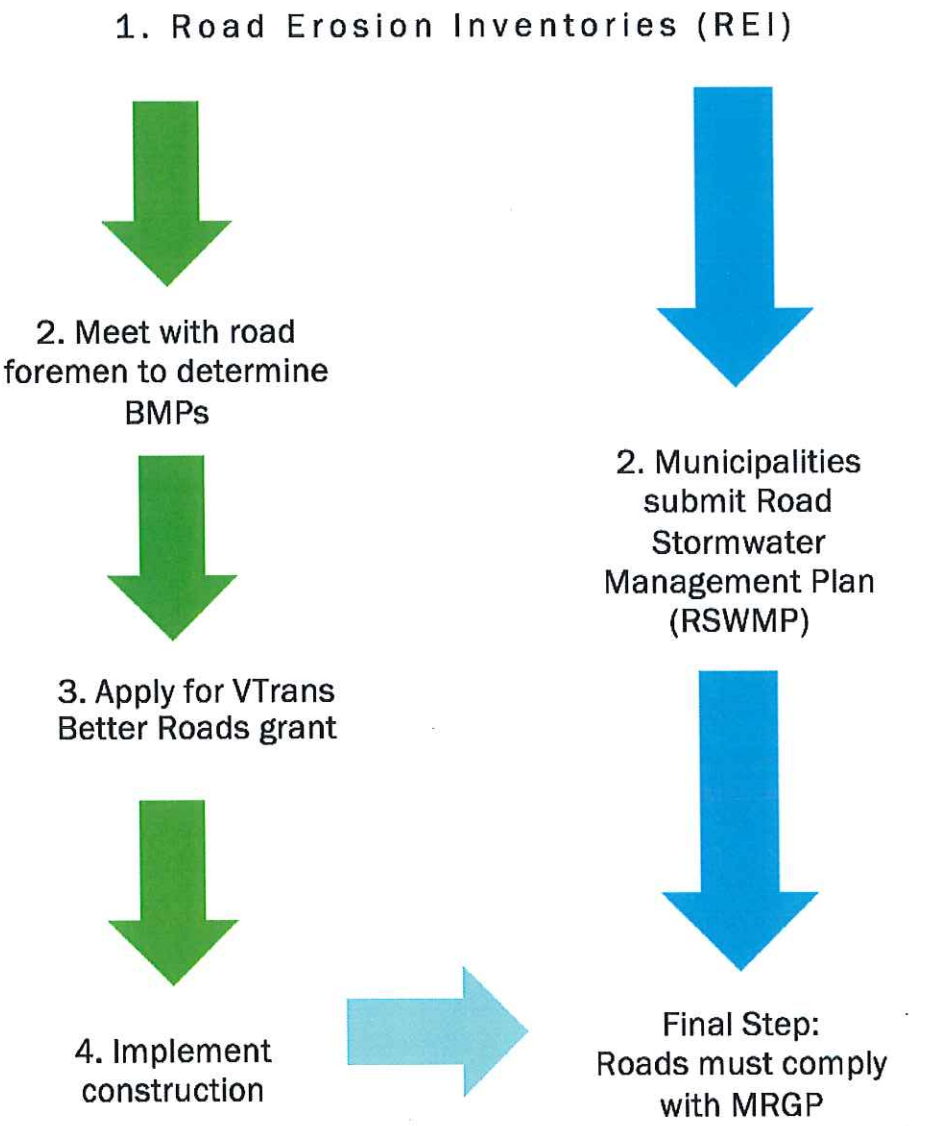






Images created by TRORC staff

Figure 1 Permit and Grant Process



Flow chart created by TRORC Staff

Town of Warren, Vermont
2019 Local Hazard Mitigation Plan

Prepared by the Town of Warren and CVRPC

Date of Adoption: _____, 2019

Effective _____, 2019
Date of final Approval by FEMA
Plan Expires 5 years from FEMA Approval:

_____

Town of Warren, VT
2019 Local Hazard Mitigation Plan Update

Prepared by the Town of Warren and CVRPC

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1. Introduction

In accordance with the Stafford Act, municipalities may perform mitigation planning and be eligible to receive increased federal funding for hazard mitigation measures. (42 U.S.C. 5165).

The impact of expected, but unpredictable natural and human-caused events can be reduced through community planning. The goal of the Warren Local Hazard Mitigation Plan, hereinafter referred to as the Plan, is to update the all-hazards local mitigation strategy that makes Warren more disaster resistant and reduces its risk from hazards.

Hazard mitigation is any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. FEMA defines a natural hazard as a source of harm or difficulty created by a meteorological, environmental, or geological event. Based on the results of previous Project Impact efforts, FEMA and State agencies have come to recognize that it is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck. This Plan recognizes that Warren has opportunities to identify mitigation strategies and measures during all of the other phases of emergency management – preparedness, response, and recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, where the hazards are most severe and identify local actions that can be taken to reduce the severity of the hazard. These actions and measures, also known as "hazard mitigation strategies," can 1) alter the hazard by eliminating or reducing the frequency of occurrence, 2) avert the hazard by redirecting the impact by means of a structure or land treatment, 3) adapt to the hazard by modifying structures or standards, or 4) avoid the hazard by preventing, limiting, or relocating development, improving public education, or ensuring development is disaster resistant.

2. Purpose

The Warren Local Hazard Mitigation Plan is part of the town's overall municipal planning efforts to enhance the community's resilience. This Plan is an update of the Warren 2012 Local Hazard Mitigation Plan. The purpose of this Local Hazard Mitigation Plan is to assist Warren in recognizing hazards facing their community, ranking them according to local vulnerabilities, and identify strategies to reduce risks from acknowledged hazards of highest concern based on current information. The town reviewed, evaluated, and revised the 2012 plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities. New information has been incorporated in the Plan making it up to date, stronger, and more useful to the Town of Warren officials and residents who will implement the actions and measures going forward. Implementation of this plan will make Warren more resistant to harm and damages from all hazards in the future, and will reduce public costs.

Warren strives to be in accordance the strategies, goals and objectives of the 2013 Vermont State Hazard Mitigation Plan, including an emphasis on proactive pre-disaster flood mitigation for public infrastructure, good floodplain and river management practices, and fluvial erosion risk assessment initiatives. It is noteworthy to mention the State of Vermont Hazard Mitigation Plan is currently in the process of being updated with an intent to complete the update process by November 2018. The State initiative is known as Vermont Stronger: Vermont's 2018 State Hazard Mitigation Planning process. The State presented the draft priority actions and gathered input at a kickoff workshop held on July 24,

2018. New working groups were identified and launched to carry forward the recommendations and continue building connections among resilience practitioners in Vermont.

The 2019 Warren Local Hazard Mitigation Plan is an update of the 2012 plan. Updates to the Plan include the following:

- Current information incorporated since the last plan update done in 2012.
- The 2012 mitigation strategies/actions chart is updated to reflect the current status of these strategies/actions.
- The addition of a new mitigation strategies/action section that reflects the current priorities and intended actions of the community over the next five years.
- The hazards are updated to reflect changes in the communities' priorities.
- The Hazard Ranking Methodology (see attachment) used in this 2019 Plan is updated and more robust than the hazard ranking methodology used in the 2012 plan.
- The updated Hazard Analysis Map reflects current information, including Tier II sites and critical community assets.
- A Fluvial Erosion Overlay Map is added to this plan.
- Flood and Erosion Hazard Areas Map is added to this plan *taken from draft town plan 2018 page 19 figure 6.
- Add MRGP Road inventory maps of hydrologically connected roads and high priority locations.
- Plan update process.
- Plan maintenance process.
- Added template for mitigation strategy tracking.
- In addition, data resources, plans, studies, and other information available over the past five years has been incorporated into this Plan as applicable.

3. Community Profile

Geography, Watershed, Landscape:

Located in the southwestern corner of Washington County, the Town of Warren is 40.14 square miles and is bounded by the two other Mad River Valley Towns of Fayston and Waitsfield to the north, by Northfield to the east, and by the Addison County towns of Granville and Lincoln to the south and west respectively. The Village of Warren is nestled in a valley between the Green Mountain range to the west and by the Northfield Mountains to the east. The two parallel ranges come together to form Granville Gulf to the south. There is a plateau in East Warren at elevation of 1,200 – 1,500 feet. The mountainous areas and steep slopes support the ski and tourism industry which is a main economic base for the community and region.

Warren is located in the Winooski River Basin (Basin #8) and wholly within the Mad River sub basin. The Mad River is one of the seven important tributaries of the Winooski River which flows through the valley in a south to north direction joining the Winooski River in Middlesex. The Winooski River eventually enters Lake Champlain in Colchester Vermont. The Mad River is 26 miles long and drains an area of approximately 143 miles originating in Granville Notch in the town of Granville and then proceeds through the middle of Warren on its way to the Winooski River. Several streams and brooks enter the Mad River in Warren. The more notable ones being Mill Brook, which drains Blueberry Lake, Stetson Brook, Lincoln Brook, Freeman Brook, Bradley Brook, and Clay Brook with its tributary, Rice

Brook. The steep upland characteristics of the Mad River and its tributaries make Warren more prone to the hazard of fluvial erosion than to inundation flooding (2018 Draft Town Plan).

Pollution of Lake Champlain, especially high phosphorus levels, is a concern of Vermont. Over the past five years, efforts to address the issue have included the passage of Vermont's Clean Water Act or Act 64 in 2015. This legislation requires development of a comprehensive plan to improve and protect the water quality of Lake Champlain by reducing water pollution from all aspects of the landscape: forests, farms, stormwater, developed lands, gravel and paved roads, parking lots, wastewater treatment plants, and stream instability. The Vermont Clean Water Act has a significant impact on the Town of Warren creating the need for increased administration, permits and fees, technical expertise, assistance and support from outside sources, and will require costly, labor intensive upgrades and improvement to the town's infrastructure in the upcoming years ahead.

Warren is currently working with the Central Vermont Regional Planning Commission (CVRPC) and the Friends of the Mad River (FMA) on developing a Stormwater Master Plan for the valley and is working with the Agency of Transportation (AOT), Department of Environmental Conservation and the CVRPC Transportation Planner on the towns Municipal Roads General Permit (MRGP) and implementation of the associated hydrologically connected road inventory. The MRGP requires municipalities to submit a Road Stormwater Management Plan (RSWP) that includes the road erosion inventories and implementation plan and schedules by the fall of 2020. These two initiatives, as outcomes of Act 64, will not only benefit Lake Champlain but will help reduce Warren's risk and vulnerability to hazards such as flooding/fluvial erosion that is exacerbated by stormwater runoff. The Clean Water Fund was established to provide a source of funding to assist towns with implementation measures and compliance under the Act.

In 2017, Central Vermont Regional Planning Commission (CVRPC) contracted with Watershed Consulting Associates to develop a Stormwater Master Plan (SWMP) for the five valley towns of Duxbury, Moretown, Fayston, Waitsfield, and Warren. This Stormwater Master Plan will serve to reduce sediment and nutrient pollution in the Mad River watershed, and ultimately the Lake Champlain Basin. The Friends of The Mad River is assisting the CVRPC with the project by providing community outreach and facilitating stakeholder meetings. One major component of the project will be for the consultant to deliver 30% design for 25 stormwater sites (five per municipality). These sites will be chosen by the stakeholder group (municipalities and Friends of the Mad River) based on consultant recommendations. The project is expected to go through 2019.

Additional storm water projects planned for 2018 include the implementation of the grant received for the Warren School Campus Parking lot and the lower end of Fuller Hill Road to Main Street.

Under Act 64, Vermont is required to develop a Tactical Basin Plan for each of its 15 river basins that are to be adopted on a 5 year recurring cycle. The last Winooski Tactical Basin Plan is dated 2012. A preliminary draft of a new Winooski River Tactical Basin Plan was released in April 2018 by the Vermont Agency of Natural Resources (ANR), Watershed Management Division. Recommended implementation strategies in this preliminary 2018 draft plan are based on a 2017 assessment report titled, *DEC Basin*

8 - Winooski River Watershed Water Quality and Aquatic Habitat Assessment Report, VT ANR DEC Watershed Management Division Monitoring Assessment and Planning Program June 2017.

Over the past five years, Warren has, in partnership and collaboration with Friends of the Mad River and others, implemented recommended top priorities found in the 2012 Winooski River Basin Plan and foresees further implementation of recommended priorities found in the updated 2018 basin plan as applicable and as funding, priority, and town capacity allows. The following recent activities of Warren supported the 2012 Winooski River Basin Plan. As a result of these implementation measures, Warren has reduced its vulnerability to natural hazards.

2012 Winooski River Basin Plan –Top priorities supported by Warren actions/strategies.

Priority: Identify culvert replacement projects in the basin, including the Mad River watershed, that will improve geomorphic stability of the stream as well as improve fish passage.	
Action	2013- FMR worked in partnership with the Vermont Agency of Natural Resources, VT Fish and Wildlife, and the US Fish and Wildlife Service to prioritize culverts in the watershed for upgrade to promote aquatic habitat and flood resiliency. Warren was identified with one of the priority sites.
Action	2015 - Replacement of failing culvert over Bradley Brook with a new, larger structure that allows safe passage of brook trout upstream to cold water habitat, allows floodwaters to pass reducing risk of damage to people and property, and requires less costly maintenance.
Action	2015 - West Hill Road (near Sugarloaf Farm Road) and Lincoln Gap Road (near Hanks Road) major culvert replacements and upgrades - using US Fish and Wildlife Service concept of natural gravel bottom culvert that can be negotiated at any water level by aquatic biota. Work contracted out to DuBois Construction Co.
Action	2017 - Engineered design for new culvert for Lincoln Brook that is fish and flood friendly, longer lasting and low maintenance.
Action	2012 – 2017 Warren has completed numerous culvert upgrades and improvement projects. And in 2014 applied for grants to assist with the replacement of the western abutment of the Warren Covered Bridge and protecting the stream bank directly downstream from further erosion.
Priority: Work with towns to protect river corridors and promote flood resiliency by establishing Fluvial Erosion Hazard zones and buffer zones in local zoning.	
Action	2013 - With the support of the Friends of the Mad River (FMR), the Town of Warren developed and adopted an official Fluvial Erosion Hazard Overlay effective 11/12/2013. The regulation prevents future development in erosion prone areas reducing the risk of loss of life and property damage.
Priority: Encourage use of rivers and lakes in the basin to increase people's appreciation.	
Action	FMR hosts special events for all ages to celebrate the Mad River.

The majority of Warren is forested with approximately 22,000 acres or 85% of its land area (Draft 2018 Town Plan). According to the Mad River Valley 2017 Annual Data Report prepared by the MRVPD, there are 27,392 acres of land, private and public, under conservation or open space management and natural resource protection. These lands include the National Forest Service, town forests, family

farms, productive forestlands, and riparian lands. These efforts contribute to the community's overall resiliency and reduce their vulnerability to hazards.

In 2014, the town received, by donation, two pieces of land fronting the Mad River. One was the Rewinski FEMA buyout property which was turned into a river access point and small lightly maintained park. The other, a gas station, (Top Gas parcel), which received state environmental clearance. This same year the Warren Conservation Commission drafted an overarching management plan for the 3 town-owned floodplain properties located along the Mad River (Riverside Park, Rewinski FEMA buyout, and Aldeborgh /Roe parcel southwest of Kingsbury Bridge). The Friends of the Mad River have since provided technical support and guidance to the Warren Selectboard and Conservation Commission as they consider management practices for the three floodplain properties. In keeping with the town's efforts to reduce its risk and vulnerability to the hazard of flooding, management that maximizes floodplain function and recreational values are sought.

Population, Housing, Development:

The 2010 census showed Warren with a population of 1,705 persons living in 771 households. These figures did not factor in the seasonal population that Warren supports. Of these 771 households, 426 were family households and 345 were nonfamily households (not related by birth, marriage, or adoption). When looking at the 2010 housing occupancy census data, the 771 occupied housing units were separated between owner occupied (590) and renter occupied (181). The 2010 census data shows the total number of housing units in Warren at 2,232 which factors in the vacant housing units (1,461); those that are seasonal, recreational, and occasional use, vacant rentals, unoccupied sold and other vacant units. Based on the census data, less than half (35%) of the housing units in Warren were occupied by year round residents, the majority (60-65%) were part time seasonal or second homes. This disparity remains true today and is an underlying cause of the affordable housing issues facing the Town and the greater Mad River Valley (MRV). Based on the MRV 2017 Annual Data Report prepared by the MRV Planning District, 53% of the housing units in the Mad River Valley (Warren, Fayston, and Waitsfield) are seasonal or vacation homes compared to 44% which are primary residences, the other 3% are vacant units.

Between 2010 and 2015 the total number of seasonal homes as a percentage of the total MRV housing units has increased from 48% to 53% as shown in Figure 27 taken from the MRV 2017 Annual Data Report.

A snapshot of available housing in **Figure 27** shows a majority of housing units in the MRV to be seasonal or vacation homes (53%), compared to primary residences (44%), and a small percentage of vacant units (3%). The number of seasonal homes has increased as a percentage of total MRV housing units between 2010 and 2015, from 48% to 53%.

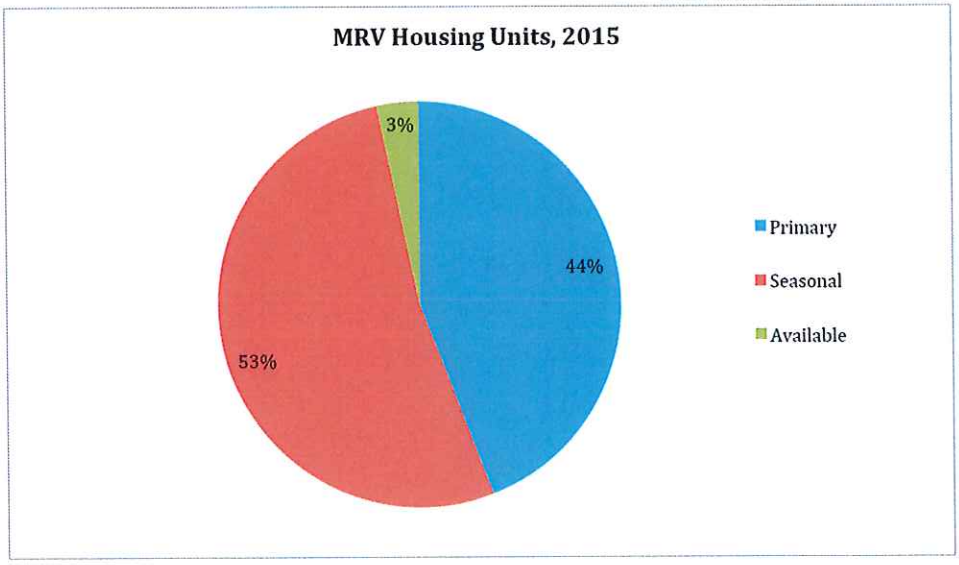


FIGURE 27- SOURCE: 2015 AMERICAN COMMUNITY SURVEY

Since the 2010 census, Warren has seen its population age and household size get smaller creating a need for housing to fit smaller families, individuals, and an elder population that is downsizing. A discussion and projections on housing for Warren and the Mad River Valley can be found in the Mad River Valley 2017 Annual Data Report and the 2017 Mad River Valley Housing Study prepared by the Mad River Valley Planning District (MRVPD). Figures 19, 20, 23, and 26, taken from the Mad River Valley 2017 Annual Data Report, depict the housing trends in Warren and the MRV. See figures below.

Figure 19 shows the number of primary homes sold has declined since its peak in the early 2000s. In 2016, however, Waitsfield and Fayston both saw small decreased sales, while Warren saw a strong uptick in primary residences sold. There were 15 primary residences sold in Waitsfield (down 1), 11 in Fayston (down 3) and 26 in Warren (up 12). Statewide, primary home sales increased to 6,834 in 2016 from 6,473 in 2015.

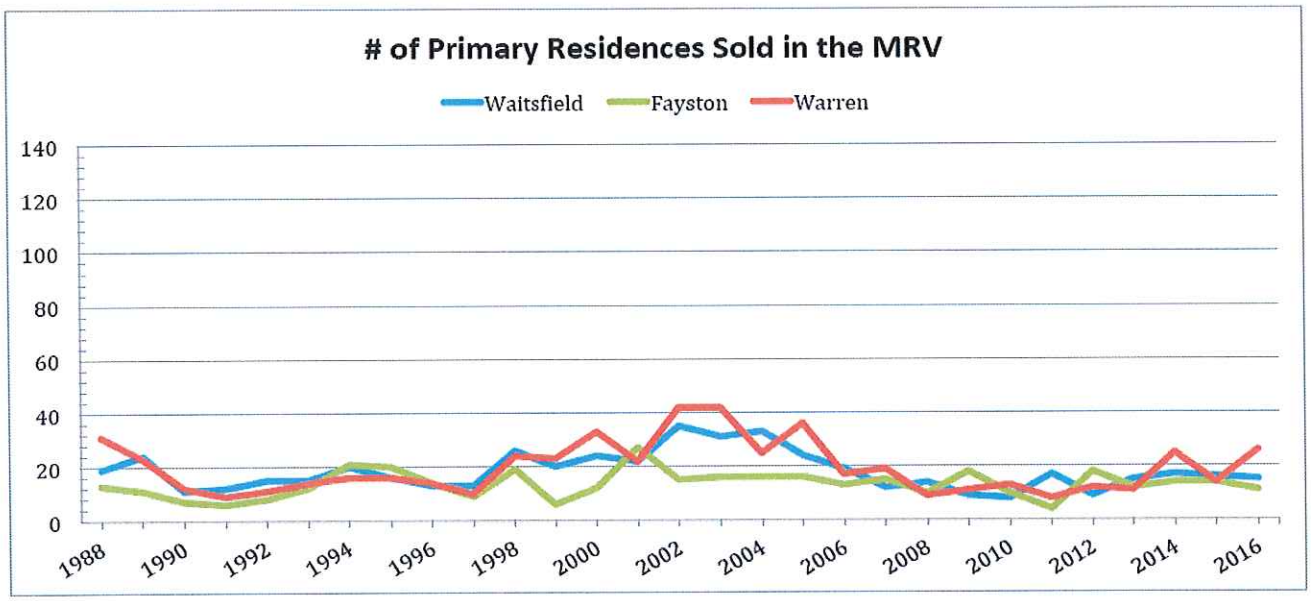


FIGURE 19- SOURCE: VT HOUSING DATA

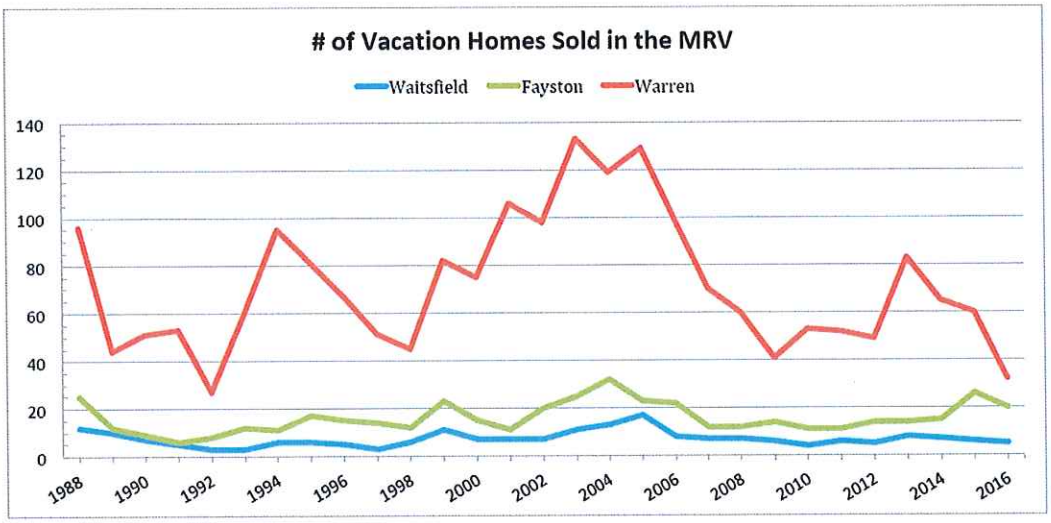


FIGURE 20- SOURCE: VT HOUSING DATA

Figure 20 shows Warren with the greatest overall volume of vacation homes sold across the MRV, while sales remain relatively flat in Waitsfield and Fayston. However, 2016 saw declines across the MRV, the greatest in Warren. Warren experienced the steepest post-recession declines, which had recovered in 2013 (although not to pre-recession levels), but has since experienced declines. Vacation homes include condominiums that are not primary residences, as well as other non-primary residences. Most of these vacation homes are found closer to Sugarbush Resort. In Warren, only 32 vacation homes were sold in 2016 (versus 60 the previous year); Fayston and Waitsfield had 20 and 5 sales, respectively, compared to 26 and 6 in 2015. 1,418 vacation homes were sold statewide in 2016, down from 1,877 the previous year.

While the raw number of single-family homes permitted is important, the total dollars attributed to those permits is also an important figure.[12] **Figure 26** shows an increase in the cost of construction for Single Family Homes in both Fayston and Warren in 2016, while decreasing slightly in Waitsfield compared to the previous year. Warren's significant increase is consistent with a similar trend in the number of single-family home permits issued in 2016.

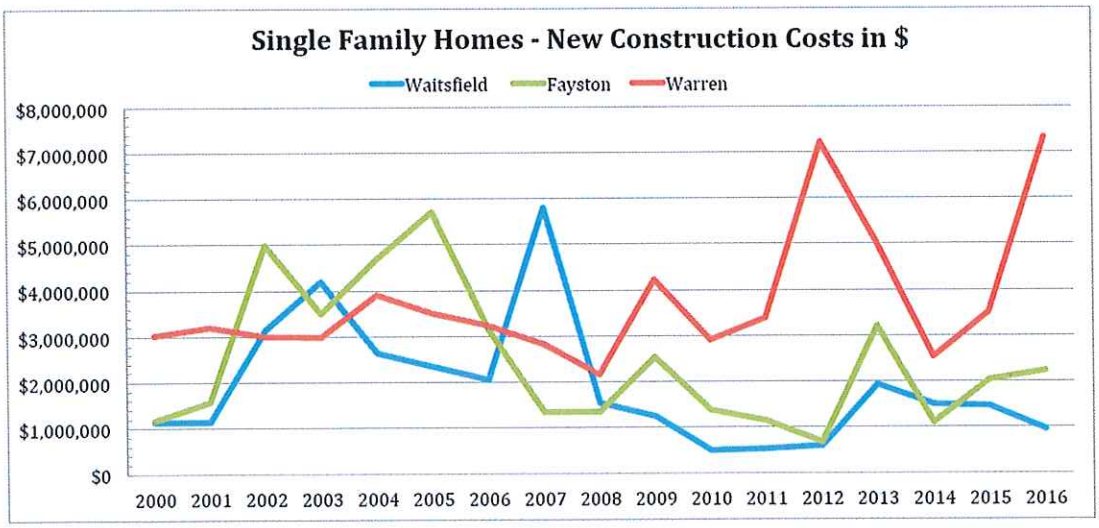


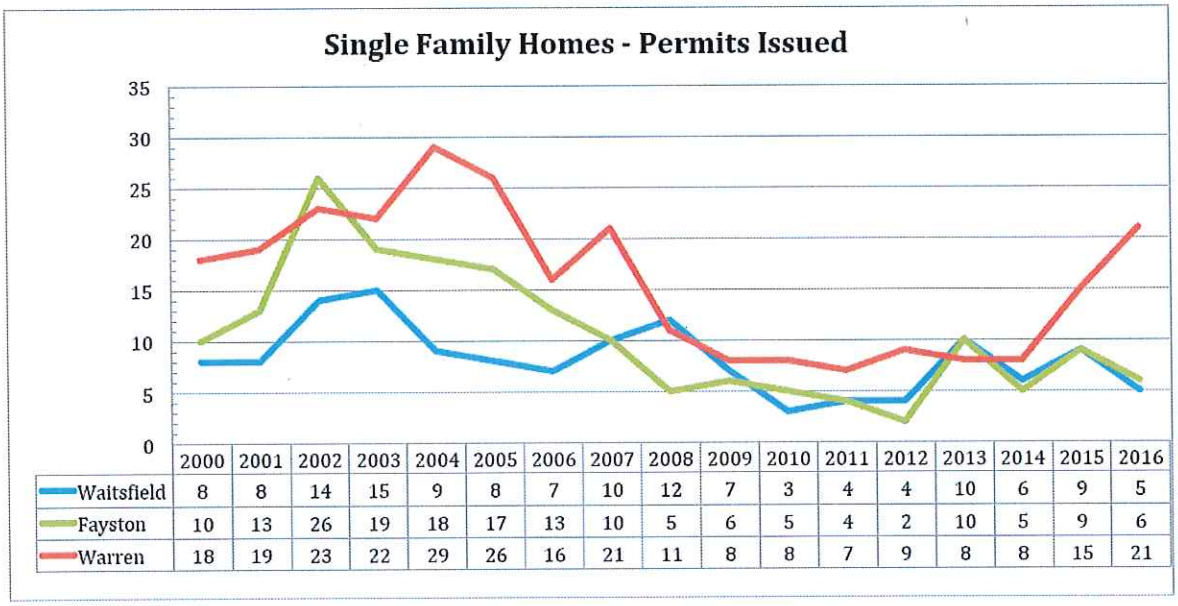
FIGURE 26- SOURCE: U.S. CENSUS BUREAU, TOWN ZONING ADMINISTRATORS AND/OR LISTERS

[12] In the past, this data was based on the US Census Building Permits Survey, but due to discrepancies with the Annual Town Reports, all of the data was updated using the Annual Town Reports and/or zoning administrators and listers in 2016.

The housing stock in Warren was predominately built during the twenty year period 1970 – 1990 and satisfied the vacation home and second home housing market. These housing units are nearing 50 years in age and in need of repair and improvement upgrades, especially for energy efficiency and fire safety (Draft 2018 Town Plan, Annual Warren Town Reports).

In 2014, the Warren Grand List saw its first increase since 2008 due to new construction; this despite the loss of 36 condominium units due to a February fire at Mountainside Condominium Association. (Lister's Report 2014). In 2015, permit approvals were granted for substantial development in the ski resort area. At Gadd Brook a Planned Unit Development for 16 condominium units was approved with ground breaking taking place in June of the same year. The Mountainside Condominium Association reapplied for the rebuild of 36 units previously destroyed by fire in 2014. The Fire Department and Selectboard met with the Sugarbush Resort to facilitate and improve upon the impacts of the Gadd development on public facilities and services and promote fire safety for the unit occupants (Warren Selectboard 2015 Town report). The sale of vacation homes in Warren over the last five years had been on a decline however the sale of primary residences has been up and down, with a notable rise in 2016. In the 2016 Lister's Report it is stated, "market still fairly slow in most areas, land sales very far and few between." However, despite the slow market, Zoning permits for single family homes were up significantly in 2015 and 2016 which can be an indicator of new construction.

Zoning permits serve as a leading indicator of new home construction. **Figure 23** shows a large increase of zoning permits in 2016 issued for single-family homes in Warren, and less single-family home permits for Waitsfield and Fayston compared to 2015.[10]



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Waitsfield	8	8	14	15	9	8	7	10	12	7	3	4	4	10	6	9	5
Fayston	10	13	26	19	18	17	13	10	5	6	5	4	2	10	5	9	6
Warren	18	19	23	22	29	26	16	21	11	8	8	7	9	8	8	15	21

FIGURE 23- SOURCE: U.S. CENSUS BUREAU, ANNUAL TOWN REPORTS

[10] Permit numbers for this graph in past years were found in the US Census Building Permits Survey. In 2017, all of the permit numbers in the graph were updated using the Annual Town Report from all three towns in order to increase accuracy of the data.

Warren Village is comprised of a cluster of historic buildings, including a general store, inn, post office, church, library, municipal offices, town hall, fire house, and private residences. In 2014, CVRPC assisted in renewing the Warren Village Center Designation. Village designation renewal has a five year term. According to the Town Plan, "the potential for locating additional development in the Village is limited." In 2006, the Planning Commission spearheaded a long term plan for the municipal facilities and village area. Over the past five years the long range planning has taken shape and come to fruition, in part due to the adverse effects from the disastrous 2012 spring flooding and Tropical Storm Irene in 2011.

In 2013, as part of the follow up to Tropical Storm Irene and the spring floods, Warren was selected as one of seven designated villages/downtowns to receive extensive community planning and economic development planning to target strategies for flood recovery work. Funding was provided by a Community Development Block Grant specific to the disaster relief efforts for Vermont. Spearheading this effort, Vermont Downtown Action Team (V-DAT) conducted a well-attended community charrette in 2014 to gather input and ideas. Later that year, the final report of V-DAT was submitted and funding for implementation was made available. At the same time, the *Disaster Recovery and Long-Term Resilience Planning in Vermont, U.S. EPA Smart Growth Implementation Assistance Project, Policy Memo for the Mad River Valley, August 2013* was released.

In 2014, the demolition of the Ruby Blair house took place in the village. This removal/demolition was envisioned as part of the towns 2006 planning efforts. A charrette was held to gain ideas for the creation of a village green which would address parking, motorized and pedestrian flow, and stormwater management.

In 2017, the implementation of the Main Street Improvement Project in the heart of Warren Village was completed, made possible by an economic stimulus grant related to Tropical Storm Irene (CDBG funds), Better Back Roads grant, VDAT and a match with town funds. The focus of the project was to provide traffic calming, pedestrian centered space in the heart of the village and address stormwater project related issues. Resurfacing sections of the Town right-of-way with different surface textures and materials helped to redefine the village center by slowing traffic while effectively addressing surface storm-water control. (Planning Commission 2017 Annual Town Report). The project cost $450,470. Future projects planned for this area include a town green, further development of a stormwater drainage master plan and paving of the municipal parking lot. The Town Green project is projected to begin in 2018. The completion of these mitigation projects continue the successful efforts of Warren to build a more resilient community.

A second area of development is located around the base of Sugarbush Ski area, located northwest of the Village and accessed via the Sugarbush Access Road. The Sugarbush Village area/Lincoln Peak Base area is Warren's largest growth area and is the "focal point for the Valley's tourist industry" and additional year round residential housing. It consists of condominium development, lodging facilities, restaurants and retail business. An additional area of concentrated development is Alpine Village; a residential neighborhood, comprised of 290-acres, located in the southeast quadrant of Warren. According to the Warren Lister's, "Alpine always has a brisk resale turnover." (Lister's Report 2015). The ski resort development was planned in the 1960's for primarily seasonal/recreational/vacation uses, yet many structures have been converted to year-round residences. Environmental constraints

will limit future development. The earlier construction took place when different building codes were in place from what is present now. Many units were built with and still have zero-clearance wood burning fireplaces. These fireplaces can pose a hazard if not properly installed, inspected, and regularly maintained. New construction follows more constringent building codes that enhance public safety and energy efficiency. In 2014, the Rice Brook Condominiums were built without the inclusion of wood burning units or stoves.

A Memorandum of Understanding was crafted in 1983 between the valley towns, Sugarbush, CVRPC and the State of Vermont which is still in effect today for the purpose of phasing any expansion to increase the capacity of the mountain by Sugarbush in a manner that does not overburden the valley's capacity to accommodate it thus maintaining a balance between the resort activities and the public facilities (Draft 2018 Town Plan). Sugarbush is a top ski destination with plans to expand its capacity over time. In a November 25, 2016 USA TODAY article, 10 Best Readers' Choice: Ski & snowboarding winners, Sugarbush resort was ranked #2 in the top ten for the category of "Best Ski Resort" in the United States. (Town of Warren Webpage). Warren is seeing the transition to four season tourism as Sugarbush expands its facilities to accommodate year round activities and events that take advantage and promote Warren's natural beauty, outdoor recreational opportunities, and cultural activities. (Draft 2018 Town Plan). The MOU is an important planning tool in this process.

According to the Town Plan, approximately 4.1% of the land in Warren is developed as residential, 0.26% is commercial and the majority of the land remains forested (84.9%).

Overall, new development since the 2012 LHMP has not increased the communities' vulnerabilities in part due to the changes to the land use regulations and the development of new ordinances in the past five years which has helped to reduce the risk to hazards.

Land Regulations and NFIP:

The Town is involved in a current rewrite and update of the Town Plan, and have hired Place Sense, Brandy Saxton to assist in this task. In conjunction, CVRPC worked with the Planning Commission on an initiative to include consideration of Green Infrastructure and Low-impact development into the Town Plan update and bylaws. The Town Plan should be completed by 12/31/2018. The *Town Plan, Warren, Vermont, 2010* has expired. A draft of the 2018 Town Plan was posted on the newly updated Town website for public comment in the late winter/early spring of 2018. The plan includes objectives and strategies for Resource Protection; Land Use and Development; Resiliency, Sustainability, and Adaptation; Infrastructure and Transportation; Community Facilities and Services; Administration and Governance; Regional Coordination and Cooperation; Maintaining Rural Character; Fostering Appropriate Growth and Development; and Promoting Effective, Efficient and Responsible Governance.

The *Warren Land Use & Development Regulations, As Amended & Adopted by the Warren Select Board August 24, 2010* outline zoning districts and development standards to protect steep slopes, headwaters and drinking water, and encourage development within proximity to public services and facilities. The zoning regulations also include a Flood Hazard Overlay District, established "to promote public health, safety and welfare by preventing or minimizing hazards to life or property due to

flooding." In 2012 certain sections of the zoning regulations were updated including the Warren Village District, Planned Unit Developments (PUD's), and Fluvial Erosion Hazard Overlay.

Warren has participated in the National Flood Insurance Program (NFIP) since 9/1/1977, community ID #500121. Land use regulations include a Flood Hazard Overly District, designed to prevent or minimize hazards to life or property due to flooding and the recent 2013 Fluvial Erosion Hazard Overlay designed to protect river corridors and prevent future development in erosion prone areas reducing the risk of loss of life and property damage. These regulations promote flood resiliency by establishing Fluvial Erosion Hazard zones and buffer zones in local zoning. Over the past five years with the additional Fluvial Erosion Hazard Overlay, the community's vulnerability to flood hazard has been reduced.

The first Warren FIRM (Flood Insurance Rate Map) was published in 06/28/1974. In 2013, official Digital Flood Insurance Rate Maps became available for Warren with the current effective maps dated 3/19/2013, Community Panel #50053C-. Printed digital panels along the Mad River showing the floodway are available, however much of the Town is mapped Zone X, areas of minimal hazard, and panels are not printed. Using 2017 data, Warren has 117 properties and 15 structures in the Special Flood Hazard Area (SFHA) or 100 year floodplain; 14 residential and 1 commercial. The total of these properties is $26,716,800 based on the average grand list value. In the fluvial erosion hazard zone, Warren has 171 properties, totaling $34,610,400 based on the average grand list value. There are 2 repetitive loss properties in Warren and one non-mitigated residential repetitive loss property (ANR 2016 database). Warren has 27 active NFIP policies 7 which are in the SFHA/A-Zone. Enforcement of Warren's flood hazard regulations is performed by the Zoning Administrator. Consideration to enroll in the NFIP Community Rating System (CRS) is dependent upon meeting the eligibility criteria and having adequate administrative resources necessary for enrollment and ongoing program maintenance; without these, CRS enrollment is likely to be a significant challenge for Warren and a deterrent for participation.

Warren is eligible under the Vermont Emergency Relief and Assistance Fund (ERAF) to receive state funding to match Federal Public Assistance funds after a federally declared disaster. Communities that take specific steps to reduce flood damage can increase the percentage of state funding they receive from 7.5% up to a maximum of 17.5%. At the time of this Plan development, Warren has an ERAF rating of 7.5%, however the rating will increase with the submission of the draft plan into State review. (VEM) Warren has taken the specific steps to reduce flood damage by 1) participating in the National Flood Insurance Program, 2) adopting standards that meet or exceed the current Vermont Roads and Bridge Standards 2013, 3) adopting a Local Emergency Operations Plan which is renewed and adopted annually, 4) adopting a Local Hazard Mitigation Plan approved by FEMA, and 5) adopting Interim River Corridor protection standards (River Corridor Plan criteria). Maintaining these measures will ensure Warren the maximum state contribution rating. Warren's rating will increase with the adoption and FEMA approval of this Plan.

Warren is one of numerous communities that has adopted regulations for a subset of their watercourses (buffer setbacks, Phase 2 data-generated FEH overlays, or avoidance-based Flood Hazard Areas) prior to the ERAF Amendments that took effect on October 2014. Warren updated their Flood Hazard Area regulations in 2010. When Warren adopted their *Fluvial Erosion Hazard Overlay in 2013,*

they satisfied the interim river corridor plan requirement as well. Warren was given approval for Interim River Corridor standards. In order to retain eligibility under the River Corridor Plan criteria of the ERAF and qualify for the maximum 17.5% rate, Warren will need to update their interim river corridor standards to meet the Agency of Natural Resources (ANR) criteria. ANR will publish a statewide river corridor map updated to include existing Phase 2 Stream Geomorphic Assessment (SGA) data which towns can use in their river corridor regulations. The data release, expected to occur at the end of 2016, has been delayed and the agency has not announced a new release date. The other option to qualify for the maximum ERAF rate is for Warren to enroll in the NFIP Community Rating System (CRS) and adopt a bylaw that prohibits new structures in the Flood Hazard Area. However, Warren has elected not to pursue enrollment in the CRS at this time. The CVRPC is posed to assist the community in drafting river corridor bylaws with the release of the Phase II data.

Transportation:

The Town's primary transportation route is Vermont Route 100, which runs alongside the Mad River from north to south. This highway provides access to Waitsfield, the commercial hub of the Mad River Valley, and to Route 2 and Interstate 89 further north. The historic Village of Warren is located to the east of Route 100 on the other side of the Mad River.

Warren is part of the Mad River Scenic Byway. In 2017, the East Warren/Brook roads were paved from the Waitsfield town line to the bridge on Brook Road in the village; "Best stretch of driving/biking in the Valley" says Warren Selectboard. (Warren Selectboard 2017 Town Report). The project expended $432,000.00. In 2017, the Sugarbush bike/path study was completed with funding of $24,750 from an Agency of Transportation (AOT) grant. The Sugarbush Access Road, German Flats Road and Roxbury Mountain Road were part of the AOT High Risk Road Grant. This grant evaluated road safety from crash data and recommended the redesign of road signage and the addition of new guardrails.

The Town has seen an increase in the need to hire outside contracted work for road repair and improvement projects due to changes in state policies and regulations regarding streams and safety measures. The town has sought grants to help defray the increasing cost of performing culvert upgrades, road stabilization, paving, and other structure related projects. (Warren Selectboard 2014 Town Report). Over the last five years, Warren has engaged in significant public works projects to improve the community's resilience. Many of these projects have been in partnership and collaboration with Friends of the Mad River, Agency of Transportation, CVRPC, the Agency of Natural Resources, and Fish and Wildlife Service. Some of the more significant projects are mentioned throughout this plan. These activities have led to a reduction in the risk and vulnerability of the community's infrastructure to hazards as well as strengthening the town's partnerships with other organizations. About every 3-5 years Warren completes a culvert inventory with the assistance of the CVRPC and AOT funding for ongoing planning and management purposes. The last culvert inventory was completed in June of 2018.

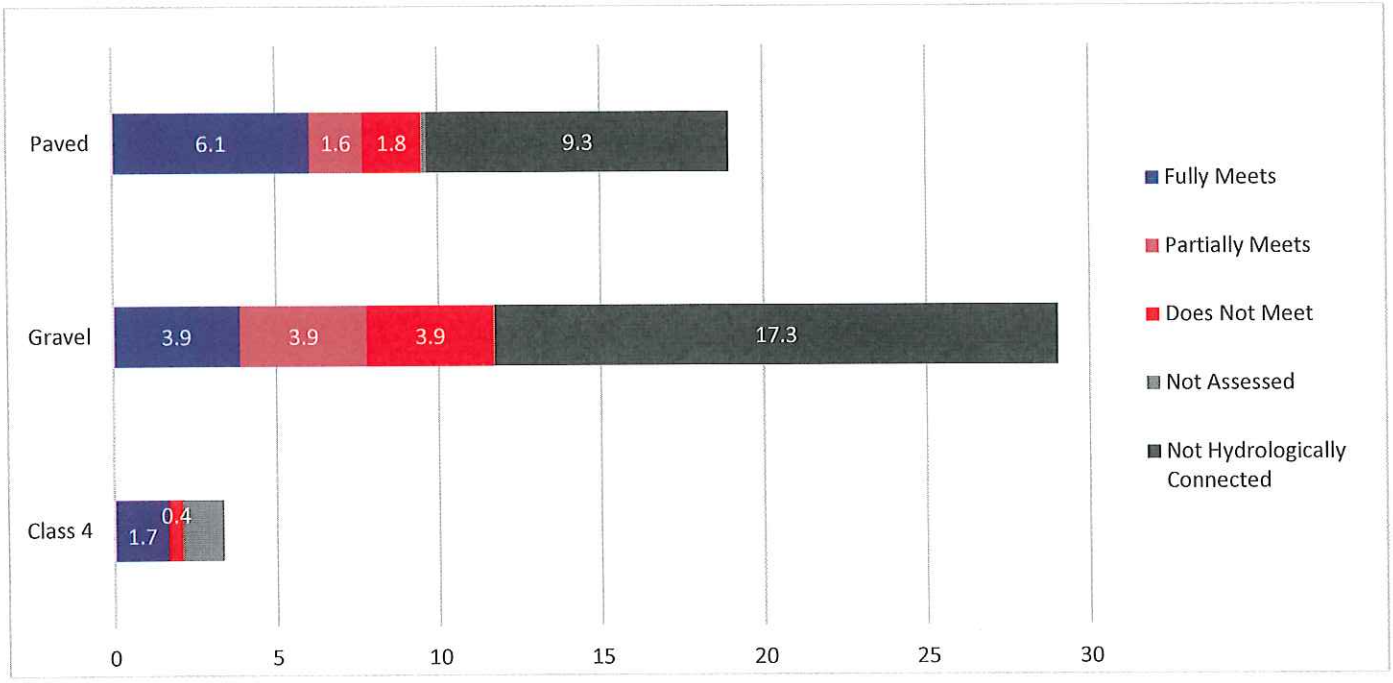
"The town of Warren is almost 40 square miles of mountains and rivers. The majority of the roads run along rivers and cross them many times. Roads typically are flanked by a steep grade to one side and a river or creek on the other. This combined with steep roads creates extra challenges and emphasizes the importance of proper road drainage installation and maintenance." (Town of Warren Road Erosion

Inventory Report prepared by CVRPC). In 2017, as part of the Municipal Roads General Permit (MRGP) requirements under the Vermont Clean Water Act, CVRPC conducted a road inventory and evaluation of the hydrologically connected road segments in Warren. The project was funded by the AOT 2017 Better Roads Program. The initial report released in 2018 highlighted those road sites with the most significant hydrological impact due to erosion within Warren and prioritized them. "Very High" priority segments are defined as being on slopes >10% that do not meet standards and must be brought to MRGP standards by 12/31/2025. As stated in the initial report, "Grants will support proper construction and maintenance of road drainage and surfaces, while the permit will set a standard with criteria that must be met. The goal is to minimize road erosion caused by storm runoff and ensure that any sediment that does erode is sufficiently diverted and filtered before reaching the watershed." Working with the CVRPC Transportation Planner and the initial report summary, Warren identified potential roads for inclusion in the work plan to include Plunkton Road, Roxbury Mountain Road, Prickly Mountain Road, Fuller Hill Road, and West Hill Road. All work is at the discretion of the town and subject to change as needed.

Graphic summaries taken from the initial report show the results of Warren's road erosion inventory.

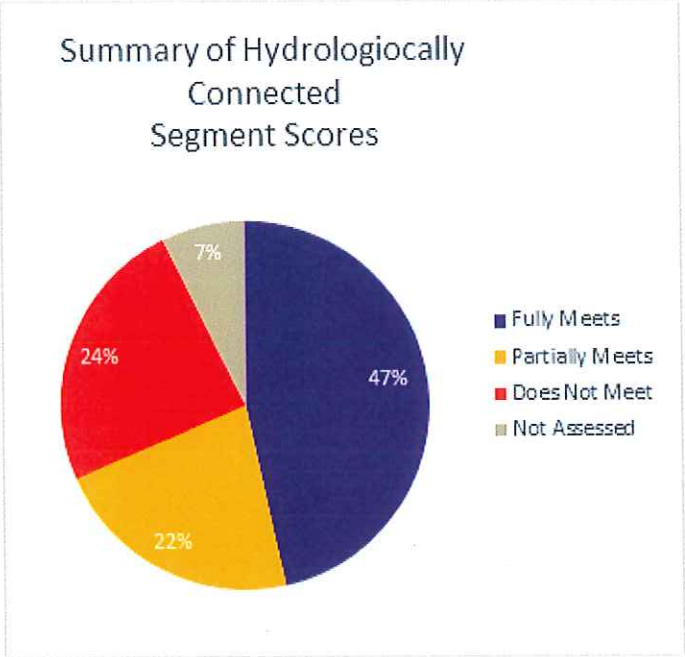
Current Condition-

This bar chart below depicts the scoring breakdown by road type for hydrologically-connected road miles within the town's total road miles. Reference to Appendix A (of the report) depicts the town with detailed results of the inventory.



The following provides a brief summary:
There are 410 hydrologically-connected road segments in Warren, or 25.5 miles (including class 4 roads).

- Of these, 46% do not fully meet standards (partially and does not meet); equal 189 segments or 11.7 miles of road.



The State has set a time table for deliverables and benchmarks starting in 2018 with the MRGP application filing, followed by a fall 2020 date to submit a Road Stormwater Master Plan that includes the road inventories with an implementation plan and schedule, and finally by the end of December 2037, all hydrologically connected road segments are expected to meet MRGP standards. Warren will continue to work with the CVRPC Transportation Planner to identify those sites to be implemented and develop a schedule for moving forward with completion. Measures to implement the initial report findings and inventory are incorporated into this Local Hazard Mitigation Plan over the next five years and will continue to be incorporated into future Plan updates as applicable.

Utilities, Water, Sewer

In regards to community facilities and services, Green Mountain Power is the electrical provider to the Town of Warren. In 2014, the Town of Warren installed a solar system to provide all the power for the Warren Elementary School and part of the town buildings in the village. The 522 solar panel array is located at the back of Brooks Field at the school. The system will generate 162Kw of net-metered power, offsetting approximately 88% of the town and school load. This effort reduces the town's carbon footprint helping reduce climate impacts. In 2015, the Town implemented energy efficiency measures in its town buildings. The heating systems of the Town Hall and Fire House were upgraded with new boilers and repairs and upgrades were made to the hot air system in the Municipal Office.

Residents and businesses located within the Village rely on a municipal wastewater system for sewage disposal needs. According to the Annual Town Report for 2017, the Wastewater treatment plant serves 116 living units connected to the system (single family homes, apartments, Mobile homes and sub-division lots). The uncommitted reserve is prioritized. The highest priority is for 10 residential living units within the service area for failed systems, followed by residential, commercial, institutional, and industrial facilities within the service area, and finally, the lowest priority is given to new applications within the service area. Similarly, Sugarbush Resort and Sugarbush Village depend on a private waste water system that serves 630 users on the Mt. Wastewater Treatment System and 94 units on the Lincoln Peak Wastewater Treatment Facility. Remaining residents and business not located within these areas rely on onsite sewage disposal or subsurface disposal facilities. The Town's Wastewater

Ordinance regulated all disposal systems up until July 2007 now the State of Vermont over see's all waste water permitting.

In 2017, the municipal water system was completed for the "municipal complex." This system serves the Warren Town Offices, Town Hall/Library building, Warren Firehouse, and the Warren United Church. Remaining residents and business not located within these areas rely on individual or small-scale community wells and spring for their water supply.

Public Safety

The Warren Volunteer Fire Department is responsible for local fire protection. It manages a station in Warren Village and at Lincoln Peak base area (part of Sugarbush Resort). Warren is a member of mutual aid systems Washington counties, working alongside Waitsfield, Moretown and Fayston Fire Departments. The nearest HazMat response truck is located approximately 47 miles away at the IBM Facility in Essex Junction. The nearest HazMat decontamination, rescue and mass care trailer is located at Barre City and Berlin Fire Departments. Michael Brodeur serves as the Warren Fire Warden. He regulates open burning in the town by issuing burning permits ("Permits to Kindle Fire"), educating town residents about safe open burning practices, and maintains relationships with the local fire departments and the Vermont Department of Forest Parks, and Recreation. As the Fire Warden, Michael is responsible for wildland fire suppression in the town and may ask the state for technical assistance and specialized equipment. The town has 23 dry hydrants.

Graph from the MRVPD Annual Data Report 2017.

EMERGENCY SERVICES

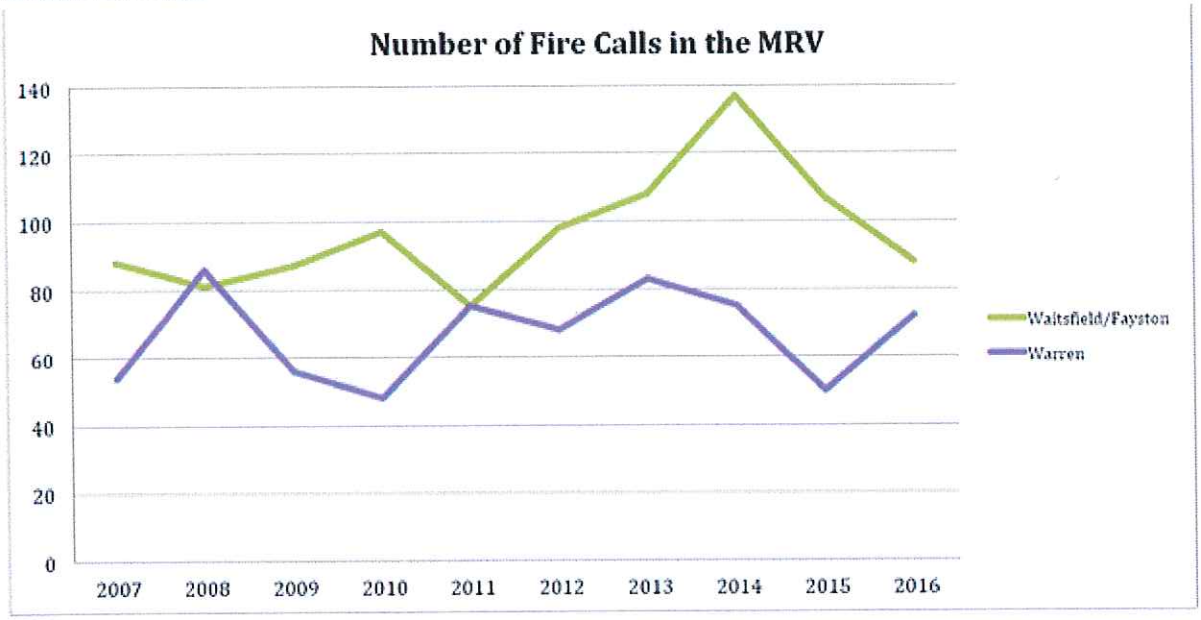


FIGURE 45- SOURCE: WAITSFIELD-FAYSTON & WARREN FIRE DEPARTMENTS

Emergency call activity shows a reduction in the number of calls in Waitsfield/Fayston for 2016 and an increase in Warren over the previous year. **Figure 45.**

The Vermont State Police (VSP), Middlesex Barracks, provides local law enforcement coverage to the Town of Warren. The VSP provide patrols and handle nearly all criminal investigations in the Town. Warren supplements the Vermont State Police coverage by contracting with the Washington County Sheriff Department to provide public safety services with a focus on traffic enforcement. In Warren, over the past five years, the trend for issued traffic citations and incidents can be categorized in the following main areas: speeding, inspection of registered vehicles, driving with a suspended license or operating without a license. (Annual Town Reports 2014-2017). Plus, as stated in the Town Plan "Sugarbush ski resort has an annual agreement with Green Mountain Concert Services to assist with traffic control during the ski season and special events."

Washington County Sherriff Dept. – Main function of the Sheriff's Department is to transport prisoners, mental health patients and juveniles, and serve civil process. The department provides services to keep the County safe such as searching out wanted persons, conducting patrols and motor vehicle check points, snowmobile patrols, offering hunter safety classes, and assisting with snowmobile safety classes.

The Warren Department of Public Safety is made up of Law Enforcement, Emergency Management and the Dog Warden. The Department focus is on the safety and welfare of the citizens and visitors of Warren. There are two constables, Gene Bifano and Jeff Campbell, both of whom are certified Police Officers. They supplement the VSP and Sherriff Department coverage. They are each EMS trained and active in the Mad River Valley Ambulance Service and Warren Volunteer Fire Department as well. In accordance with 20VSA Section 6, Local Organization for Emergency Management, Jeff Campbell also serves as the Emergency Management Coordinator for Warren.

The Town of Warren has an approved Local Emergency Operations Plan (LEOP), (formerly known as the Rapid Response Plan), that is updated and adopted annually, after Town Meeting Day and before May 1st. The current LEOP was adopted on May 8, 2018 and is due for renewal by May 1, 2019. The town coordinates with the Central Vermont Regional Planning Commission who provides technical support and guidance with the LEOP plan update. The town requires the certifying officer to be trained in ICS 402 or ICS 100 at a minimum. In conjunction with the LEOP, on April 29, 2014, the town adopted the use of the National Incident Management System (NIMS) as the standard for management and systematic approach involving all threats and hazards, regardless of cause, size, location, or complexity, in order to reduce loss of life, property, and harm to the environment.

The Warren Town Hall and the Fire Station are designated emergency shelters. The Fire Station has a backup generator. With assistance from FEMA, the Town received grants for additional generators for the Town Garage, and Sugarbush Fire Station. In April 2018, Warren applied under the Hazard Mitigation Grant Program for an Infrastructure grant to purchase and install a generator in the Town Hall, designated as a town emergency shelter in 2017 after the state's school merger policy caused the need to remove the Warren Elementary School as a town shelter site for practical reasons. At the time of this writing, Warren is still waiting on an award decision.

The Mad River Valley Ambulance Service is a 24 hour, volunteer run, emergency medical provider for the Mad River Valley with its station located in the neighboring town of Waitsfield. It provides EMS and Rescue service to Warren. The Town's Annual Report indicates the Ambulance Service responded to a total of 179 calls during 2016 in Warren (49 ski related).

All Public safety entities encourage residents, through the use of Annual reports, public announcements, and the Town website, to sign up with VT Alert, post their E-911 addresses in a highly visible location from the roadway, and use VT211 as needed in efforts to promote personal life safety and property protection.

Mad River Valley Partnerships

Friends of the Mad River (FMR) and Ridge to River Task Force – *"Friends of the Mad River is a private, membership-based non-profit organization committed to protection and enhancing the ecological, recreational, and community values of the Mad River and its watershed."*

Warren is located in the southern upper portion of the Mad River watershed. Warren is a member of FMR and residents from the community serve on the Board of Directors. The FMR promotes flood resiliency, river corridor planning, stormwater management, climate resilience and other initiatives in the watershed by working collaboratively with local governments and interested organizations both in and outside the watershed. (FMR website and Annual Reports to the Town of Warren). The goal is to identify regulations, programs and projects needed to meet changing state regulations related to water quality and to help communities prepare for and reduce the impacts of future floods." (http://friendsofthemadriver.org).

In 2013, as part of their Watershed Restoration and Resiliency efforts, FMR undertook a study funded by a grant from Green Mountain Coffee Roasters to perform a comprehensive review of the stormwater regulations of all the towns in the MRV, including Warren. Watershed Consulting Associates, LLC reviewed municipal town plans and the local zoning and subdivision regulations with respect to stormwater and erosion control. A final report was issued in April 2013; Stormwater Management Regulation in the Mad River Valley; Review and Recommendations. The study recommendations were the impetus to the formation, in 2015, of the Ridge to River Task Force and the Watershed-Wide Water Management Program (W3MP). A grant to FMR from the High Meadows Fund assisted in these implementation actions.

Warren is represented on the Ridge to River task force with a member from the Planning Commission and the Selectboard. The 5-town coalition is working on innovative ways to address stormwater runoff to help reduce the impact from flash flooding which has caused road and culvert washouts, degradation in water quality and increased maintenance costs and frequency of repairs to communities in the Mad River Valley (MRV). A collaborative effort is being made to develop a long-term approach for building flood resilience and water quality in the valley by improved and coordinated stormwater management. The initial focus of the Watershed-Wide Water Management Program is stormwater runoff since this is one of the highest priority challenges facing the Mad River Valley and untreated stormwater exacerbates flooding (FMR,

Ridge To River Initiative -Building Resilience By Tackling Stormwater Together - Project Overview http://friendsofthemadriver.org). As noted earlier in this Plan, the development of the Stormwater Master Plan (SWMP) for the five valley towns is underway with a contract executed in 2017 with Watershed Consulting Associates and CVRPC. The project is expected to go through 2019.

The Storm Smart program ("Slow, spread, and sink" initiative) is a new program to help landowners understand, identify, and control stormwater runoff problems in order to protect the watershed and strengthen the climate resilience of the Mad River Valley. Under this FMR initiative and a grant from the Eco-Restoration Grant Program, funding was secured for the Warren School Campus Parking lot project in 2017. Work is expected to begin in 2018.

In addition to those activities previously mentioned in this Plan and noted in the table for implementation activities related the 2012 Winooski River Basin Plan, FMR has supported Warren in other projects aimed at protecting the watershed. This includes Tree Planting along sections of the Mad River to improve the riparian buffer in 2013, Tree Planting along the south bank of Riverside Park to improve floodplain functions in 2014, and restoration of half an acre of important floodplain at Riverside Park in 2015.

Mad River Watershed Riparian Gap Analysis: 604b: Using 604b funding from the Vermont Agency of Natural Resources, staff conducted a riparian buffer gap analysis for the Mad River Watershed. Using infrared imagery, staff identified areas along the stream banks in priority areas that lacked woody vegetation. Then, town parcel data was used to select parcels with gaps in woody vegetation along stream banks. Staff summarized parcel information, including ownership, in a table. The Friends of the Mad River will use the information for stream restoration and conservation outreach.

Mad River Valley Planning District (MRVPD) – Warren is a member of the MRVPD and provides one Planning Commission member and a Selectboard member to serve on the Steering Committee. The District was created in 1985 to support the towns in the Mad River Valley with planning programs to support the economic, social, physical, fiscal, environmental, cultural, and aesthetic wellbeing of the area. Over the past five years and going forward a focus has been on Flood Resilience and stormwater management. In 2014 they released a report from the study, MRV Economic Development Study for Flood Resilience and another report from work under the EPA's Smart Growth Implementation Assistance program.

4. Planning Process and Maintenance

4.1 Planning Process

The Warren Selectboard designated the Town Administrator, Cindi Jones as the staff person to be responsible for the initiation and oversight of this Plan update process. The Central Vermont Regional Planning Commission (CVRPC) provided support and technical assistance and coordinated efforts with the Town Administrator. The following town residents actively participated in the planning process:

Plan Update Committee members:

Bob Ackland - Warren Selectboard Vice Chair & MRVPD Representative, Ridge to River Representative

Corrie Miller - Director, Friends of the Mad River

Jeff Campbell – Town Constable, Emergency Management Coordinator, Assistant Fire Chief, and Public Safety Officer

Ray Weston - Road Foreman

Cindi Jones - Warren Town Administrator, Sewer Administrator, and Treasurer Warren Historical Society

Ruth Robbins – DRB Secretary/PC Assistant, Interim Zoning Administrator

Others

Laura Ranker – Central Vermont Regional Planning Commission (CVRPC)

Andrew Cunningham - Chair Board of Selectman, EMD, and Warren Road Commissioner

Luke Youmell - Selectboard Member

Randy Graves - Selectboard Member and Planning Commission member

Clay Mays - Selectboard Member, MRV Solid Waste Representative

Michael Ketchel – Chair Planning Commission

Jim Sanford - Vice Chair, Planning Commission

Alison Duckworth – PC Member

Camilla Behn – PC Member

Dan Raddock – PC Member

J. Michael Bridgewater – PC Member

Peter DeFreest - Warren Fire Chief

Joshua Schwartz - Ex. Director MRV Planning District

Beth Petersen - School Principal

Margo Wade - Sugarbush Resort

Central Vermont Regional Planner, Laura Ranker, and Cindi Jones (Town Administrator) met on March 7, 2018 to discuss the plan development and update process and review the FEMA LHMP guidelines. They discussed the need to form a committee to work on the update and identified key members to serve. Initial tasks were identified including the need to perform a hazard analysis and risk assessment. During Phone conversations and email exchanges, resource tools, methodologies and templates were shared with C. Jones for use by the committee to assist with the identification, prioritization, and evaluation of the hazards facing Warren and to perform the Risk Assessments. A Committee was formed in mid-March with their first meeting held on March 27, 2018.

All members of the Committee were present at this meeting. The Committee reviewed the current 2012 plan, focusing on the identified hazards and the town's current vulnerability to those hazards and reviewed the status of the current and proposed mitigations programs, projects and activities for Warren. The Town Administrator provided copies of the Local Hazard Mitigation Plan with initial markups. The Committee continued to meet during the plan update process and all meetings were open to the public. The Town website and Front Porch Forum

were used to inform residents of the update process. The 2012 LHMP and the final draft of the 2019 LHMP were posted on the Warren website. Also, the draft 2019 plan was made available for public comment at the Town Administrator's office.

Town Administrator C. Jones kept the Selectboard apprised of the Plan's development during regularly warned meetings of the Selectboard and also maintained contact with the Vice Chair of the Planning Commission. Selectboard and Planning Commission input on future hazard mitigation programs, projects and activities were shared with the Committee and incorporated into the final Plan. Select Board and Planning Commission meetings are duly warned and open to the public. Agendas are posted on the municipal website providing local residents and businesses the opportunity to attend a meeting to review and comment upon the plan.

The Town Administrator also reached out to individuals in the community to gain their input such as the School Principal Beth Petersen, Sugarbush Resort Margo Wade, and Joshua Schwartz, MRVPD Executive Director. A draft of the Warren LHMP was reviewed at the January 23, 2018 Planning Commission meeting. Public comments were received. The Committee considered all comments and identified changes made to the draft, incorporating them into the final draft Plan as appropriate.

The meetings indicated that the Town remains most vulnerable to flood (inundation flooding, flash flooding, and fluvial erosion), severe winter weather (ice storms, snow = or >18 inches), severe thunderstorms/thunderstorm winds/high winds and often associated heavy rains. Structure fires and wildfires remain as moderate threat hazards. The methodology used to perform the assessment and prioritization is described further on in this Plan and was more robust than that used in 2012.

Warren will focus on flood hazards as these events are the most common, severe, and damaging. The Town also has developed Land Use Regulations and ordinances to minimize the effect from the flood hazard and be more proactive. Several implementation strategies and actions over the past five years and future projects planned or in the works have increased the town's resiliency, reducing the impacts from flooding but the threat remains as changes in climate have made Vermont and Warren more prone to severe storms and thaws that result in flooding.

On September 14, 2018, a copy of the final draft Plan was sent electronically to members of the Warren Planning Commission, Selectboard and Plan Committee, as well as on September 18, 2018 to the following persons, for review and comment with instructions to send comments to Cindi Jones, Town Administrator by email at cjones@warrenvt.org. Comments were asked to be received by October 10, 2018.

Distribution list for public comment:
Laura Ranker, Planner with the Central Vermont Regional Planning Commission, ranker@cvregion.com
Peter DeFreest, Warren Fire Chief, peterdefreest@yahoo.com
Joshua Schwartz, Ex. Director MRV Planning District, mrvpd@madriver.com
Mark Belisle, Granville Emergency Manager, tritownps@yahoo.com

Kathy Werner, Granville Town Clerk, granvilletown@gmavt.net
Sally Ober, Lincoln Town Clerk, clerk@lincolnvermont.org
Bob Lockett, Fayston EMD, blockett@madriver.com
Pattie Lewis, Fayston Town Clerk, patti@madriver.com
Jared Cadwell, Fayston Selectboard Chair, jared@gmavt.net
Trevor Lashua, Waitsfield Town Administrator, townadmin@gmavt.net
Fred Messer, Waitsfield EMD, fmesser@madriver.com
Jeff Schultz, Northfield Town Manager, jschulz@northfield.vt.us
Tammy Legacy, Roxbury Town Clerk, townrox@tds.net
Steve Twombly, Roxbury EMD & Selectboard member, twombly@tds.net and stwombly@montpelier-vt.org
Stefan Pratt, Moretown Fire Chief and Emergency Coordinator, spratt.moretownvt@gmail.com;
Karl Lander, Duxbury EOC Chief and EMD, karl.duxburyvt@gmail.com
John Greenen, PE, Green Mountain Power Company, John.Greenan@greenmountainpower.com
Brenda Spafford, Green Mountain Power, Brenda.Spafford@greenmountainpower.com;
Ned Swanberg, VT Regional Floodplain Manager, ned.swanberg@vermont.gov;
Gretchen Alexander, VT Regional Rivers Scientist, gretchen.alexander@vermont.gov;
Dan Singleton, Washington County Forester, dan.singleton@vermont.gov;
Benjamin Green, VT ANR Dam Program, Benjamin.Green@vermont.gov;
Lt. David White, Commander Middlesex State Police Barracks & LEPC 5, David.White@vermont.gov;
Todd Keller, Washington West Supervisory Union, tkeller@wwsu.org;
Beth Petersen - School Principal;
Margo Wade - Sugarbush Resort.

Additionally, a notice for public review and comments on the final draft was posted in Front Porch Forum and on the Warren and CVRPC websites. Hard copies of the draft plan were available in the Warren Town Office, and upon request, available digitally. The deadline for public comment was October 10, 2018 with comments to be sent to Cindi Jones, Town Administrator by email at cjones@warrenvt.org.

VTANR, and a planning commission member provided comment which was considered and added as appropriate.

Additional opportunities for the public to weigh in on the planning process have been made available at committee meetings, through office appointments with the Town Administrator, and Selectboard meetings. The planning meetings focused on 1) assessing past mitigation projects and compiling information on its current and future hazard mitigation programs, projects and activities, 2) identifying and ranking the hazards significant to Warren, 3) discussion of vulnerabilities, 4) plan maintenance, and 5) public engagement. All meetings were open to the public. No public attended the working meetings of the committee, and no public comments were received at any of the meetings of the Planning Commission or Selectboard. On September 25, 2018, the draft Plan and a completed Plan Review Tool was sent to Stephanie Smith, Hazard

Mitigation Planner at Vermont Emergency Management (VEM) for initial review and comment. This started the review and approval process with VEM and FEMA.

Based on comments received on September 24, 2018 from S. Smith, revisions were made to the draft Plan prior to submittal to FEMA. Once FEMA approves the plan they will notify VEM of "Approval Pending Adoption" status. After Approval Pending Adoption, the plan will go before the Warren Selectboard for adoption. The Selectboard will hold a warned public hearing and after the hearing and at a regular Selectboard meeting will approve and adopt the Warren 2018 Local Hazard Mitigation Plan and execute the Certificate of Adoption. A copy of the executed Certificate of Adoption will be attached to this Plan. The adopted Plan and signed certification was sent to VEM for submittal to FEMA on January 10 2019. The Plan will expire 5 years from the FEMA approval effective date. During the review and adoption process CVRPC provided support and technical assistance as requested.

Public comments submitted in the future will be reviewed by the Select Board (and CVRPC Staff dependent on funding) and attached as an appendix.

Also, the Selectboard will identify an ongoing LHMP Committee whose first order of business will be to appoint a Chairperson. The LHMP Committee will update this Plan annually and provide updates at all future Town Meetings or in a report for inclusion in the Annual Report of the Town of Warren, through December 31, of a given year.

During, and after, the update process, the town used the town website to post notices and informational pieces about the updated local hazard mitigation plan. The Waterbury Record and Front Porch Forum were also utilized to provide public participation.

4.2 Plan Update Process

The Warren Local Mitigation Plan was originally adopted by the Town as an Annex to the Central Vermont Regional Pre Disaster Mitigation Plan in June 2009 and received FEMA final approval in October 2009. In 2011, the town began the process to update the plan creating a single jurisdiction local hazard mitigation plan, which was adopted by the Selectboard on 12/11/2012 and received FEMA approval on March 11, 2013, the effective date of the plan. This Plan is an update of that plan and is submitted as a single jurisdiction plan. This Plan will guide the town into the next five years and maintain the town's eligibility as an applicant for mitigation grants.

The current plan is not a significant departure from the 2012 plan; however, new analysis was done to best determine where the Town should put resources in the future. The Committee considered changes to risk based off of past events and the likelihood of future events and their impact to infrastructure and lives, and reviewed the historical and expected locations of future events to make determinations on how best to apply resources. The significant weather events history has been updated.

Analysis showed that the most significant threats (formerly called worst threats) and areas of concern remain the same from the 2012 plan and that continued effort needs to be applied to these threats and areas to mitigate risk. In 2012, Flash Flood/Flood/Fluvial Erosion; Hurricane/Severe Storms; and Winter Storm / Ice Storm/Extreme Cold were identified as "worst threat hazards", and Structure Fire; Wildfire/Forest Fire were identified as "moderate threat hazards." Priorities have not changed from the 2012 plan but have been further defined and added to. Hurricane/Severe storms is further broken down and categorized as Severe Thunderstorms/Thunderstorm Winds. High wind, not a perceived threat in 2012, is now combined with severe thunderstorm and thunderstorm winds since recent high wind storms have demonstrated a significant threat hazard to Warren. Heavy rains often associated with severe thunderstorms result in erosion and these concerns will be discussed under the severe thunderstorm category. Warren remains threatened by severe winter weather. In the 2019 Plan, focus is on the threat of ice storms and a snow storm equal to or greater than 18 inches per snow storm event. The threat of wildfire/forest fires remains a moderate threat and concern of the community given Warren's rural nature and heavily forested area which is frequented by many users for a variety of purposes. In addition, despite strides in reducing the number of housing/structure fires, a moderate threat remains and is still a high concern of the community, especially with the older existing structures built prior to current building practices and standards. Available resources will be applied to mitigate top priority threats.

Continued investments and maintenance in the town's machinery, equipment, and infrastructure and updated ordinances and regulations have positioned Warren to better address the hazards facing them. The implementation of several mitigation actions over the past five years, some not listed because the town considers them to be regular maintenance and program implementation measures, have reduced the town's vulnerability to specific hazards. Despite the fact that solid strides have been made, additional work needs to be done. Warren has benefitted from the collaborative approach to achieving mitigation on the local level, by partnering with Agency of Natural Resources (ANR), Vermont Agency of Transportation VTrans, Agency of Commerce and Community Development (ACCD), Vermont Emergency Management, Central Vermont Regional Planning Commission (CVRPC), Friends of the Mad River, Mad River Valley Planning District, Fish and Wildlife Services, Federal Emergency Management Administration (FEMA) Region 1 and other agencies, all working together to provide assistance and resources to pursuing mitigation projects and planning initiatives in Warren.

Below is a list of the revisions that have been made from the past plan and the appropriate sections for reference.

General Updates

- General reorganization/restructuring of the plan.
- Update of all data and statistics using available information (Section 3, 5 and 6)
- Update to the Community Profile with discussion on changes and activities of past five years.
- Re-evaluation, identification and analysis of all significant hazards (Section 5)
- Use of a more robust methodology for hazard assessment and prioritization (Section 5)

- Acknowledgment of implemented mitigation strategies since 2012 – see matrix below (section 4.2)
- Update Identification of on-going mitigation projects and strategies – see Existing Mitigation Programs, Projects and Activities section (Section 4.2)
- Identification of new mitigation strategies and actions for the next 5 years, (Section 6)
- Updates to Planning Process and Plan Maintenance (Section 4)
- Expanded on Town capabilities for implementing mitigation strategies (Section 4)
- Augmented Appendices with additional maps depicting recent data (Section Attachments)

Hazard Analysis Updates (Sections 5 and 6)

1. Hazard categories further defined, broken down and added to. Most significant threats ("Worst Threat hazards" of 2012) remain in 2019; moderate threat hazards of 2012 remain in 2019.

2012 category	2019 category redefined
Flood -Flooding/Flash Flooding/Fluvial Erosion -	no changes made
Hurricanes/Severe Storms Hurricane/Tropical/Severe Storms	Severe Thunderstorms/ Thunderstorm winds/High Winds
Severe Winter Weather: Winter Storm/ Ice Storm/Extreme Cold	Severe Winter Weather: Ice storm, Snow storm >= 18 inches / event
Structure Fire	no changes made
Wild Fire/Forest Fire	no changes made

2. High concern for heavy rains that result in erosion; discussion of these hazards will be incorporated into the severe thunderstorm category.

3. Review of Federally declared disasters, FEMA website, weather data, ANR resources, VT Flood Ready website, and NOAA websites.

Maps

1. Update Areas of Concern map and Local Hazards Analysis map – Add 2013 Fluvial Erosion Hazard areas and most current data for Tier II locations
2. Add MRGP Road Inventory maps of hydrologically connected roads and high priority locations.

Town Capabilities and Capacity for Implementing Mitigation Strategies

Services provided by the Warren municipality are overseen by a five member volunteer Selectboard with a paid full time Town Administrator. A seven member volunteer Planning Commission (PC) is responsible for both long range planning functions and short range

development regulation. Long range planning functions include periodic update of the Town Plan, drafting land use and development regulations to implement that plan, and offering policy recommendations on matters related to Warren's growth and development. The Commission is provided staff support from the Zoning Planning Office. The eight member volunteer Development Review Board (DRB) is a quasi-judicial body charged with administering key provisions of the Town's zoning bylaws and subdivision regulations. The Board is responsible for regulating most commercial development through the administration and interpretation of conditional use standards and reviewing landowner requests for variance from specific development standards. Regulatory functions also include review of construction in the Meadow Land, Village District and administration of much of Warren's subdivision regulations. The Board also reviews appeals of Zoning Administrator decisions. The Zoning Administrator coordinates the Board's agenda and does an initial review of all applications. Ruth Robbins serves as the Board secretary. (Town of Warren Website http://www.warrenvt.org/resources/).

The Town employs a handful of staff members to carry out services to its residents on a daily basis. Currently, the Town capacity is below 100% due to the absence of a Public Works Director, active Zoning Administrator, and a vacancy on the Selectboard for a one year term.

The following are the paid positions which are involved in hazard mitigation:

Town Clerk (Full Time): Reta Goss is the Town Clerk. She is responsible for the recording and maintenance of the land recordings, deeds and mortgages, property transfer returns reporting property sales, maps, tax records and also maintains permits of sewer systems installed after 1983.

Assistant Clerk and Treasurer (Full time): Dayna Lisaius is the Assistant Town clerk. In 2017, the treasurer position went from a one year elected term to a three year elected term. The Treasurer maintains the town and school's accounts, invests money (with the approval of the legislative body), keeps a record of the taxes voted and pays orders drawn.

Road Foreman (Full time): Ray Weston is the Road Foreman and has a crew of four full time road crew members; Chris Kathan, Andrew Bombard, Kevin Bagley and Kenneth Bagley. The Highway Department led by Ray Weston maintains and repairs almost 50.49 miles of roads, bridges and over 600 culverts, the sidewalks and municipal parking facilities. Highway Department personnel are also the towns "go-to" guys for all things in between.

Public Works Director – Longtime Public Works Director Barry Simpson passed away in 2017. The position is now chaired by the Town Administrator until the vacancy is filled.

Zoning Administrator/Flood Administrator (Part Time): Miron Malboeuf is the Zoning Administrator and Flood Administrator. As of 2018, this position has been temporally filled by Ruth Robbins due to health matters of the ZA. Ruth also serves as the Design Review Board Assistant and Planning Commission Assistant. The ZA performs the initial review of all permits and makes permit decisions under the Zoning Regulations.

Public Safety Department (two paid part time positions): Jeff Campbell is one of the two Public Safety Officers. He also serves as the Emergency Management Coordinator, and Assistant Fire Chief. Gene Bifano is the second Public Safety Officer and also serves as the Dog Warden. The Public Safety Department supports and augments the VT State Police coverage

and contract with the Sheriff Department. They promote emergency preparedness and are part of the response and recovery efforts.

Town Administrator/Wastewater Coordinator (Full time): Cindi Jones is the Town Administrator and acts on behalf of the Selectboard at their direction to support them in the management of the town and every day business. She also serves as the Wastewater Coordinator.

(Town of Warren Website http://www.warrenvt.org/resources/).

Volunteer municipal officials also play a crucial role in carrying out hazard mitigation. In addition to the volunteer PC and DRB, Warren has a Conservation Commission, Energy Committee, Recreation Committee, Historical Society, and a Fire Warden that may help plan, oversee and implement municipal & mitigation activities as applicable. Warren maintains active representation on the Ridge to River Task Force, Friends of the Mad River, the Mad River Planning District, and the Central Vermont Regional Planning Commission all which actively participate in mitigation activities and initiatives that support resiliency for Warren and the other Mad River Valley communities.

The budget is usually developed between early *November* and early *January*, and put to voter approval on the first Tuesday in March at Annual Town Meeting Day. The Selectboard is charged with developing and proposing the budget to the voters, including the budget for Highway Equipment. The towns Capital Budget includes highway department equipment, fire department equipment, bridge repairs, paving, fire protection training and personnel equipment, Blueberry Lake dam and bridge, Warren Wastewater treatment, Town Improvements, etc. There is a Capital Reserve Account for the Capital Budget items. In January of 2018, CVRPC assisted Warren to update its capital budget. The Selectboard Chair noted that capital budgeting has provided a useful tool for stabilizing the Town's tax rate. Warren has established a Blueberry Lake Dam and Covered Bridge Maintenance Fund and a Warren Department of Public Safety Major Equipment Account. In 2015, the town voted to establish a dam maintenance budget for the Historic Timber Crib Dam on the Mad River ($3,000/year for dam maintenance). After the budget has been adopted by vote of town residents, the Selectboard has the authority to modify it in cases of extraordinary circumstances; i.e. natural disaster, unexpected equipment/infrastructure failure (i.e., water well, power failure, major bridge/culvert failure). The budget is monitored several times a month by the Selectboard and Town Treasurer.

Municipal revenues are generated primarily through levy of taxes on property value. Other major sources are federal & state payments to support the town school, aid (including grants) from the Vermont Agency of Transportation for highways, and payments in lieu of taxes for land owned by the State of Vermont. The municipality also has the authority to incur debt through bonding.

Review of Existing Plans, Studies, Reports, and Technical Information:

Preparation for updating this Plan included a review of Warren's planning documents, studies, technical papers, reports, and ordinances. In addition, conversations and emails took place between CVRPC staff (GIS Planner, Transportation Director, EM Planner), Warren Town Administrator, Friends of the Mad River Executive Director, VEM Hazard Mitigation Staff, and the Mad River Valley Planning District.

The following is a listing of materials and documents reviewed for this Plan update:

- Warren, Vermont 2018 Draft Town Plan.
- State of Vermont Hazard Mitigation Plan – November 2013.
- Warren LHMP Plan Review Tool of 2013 and Town of Warren Local Hazard Mitigation Plan Update adopted December 11, 2012.
- Town of Warren Land Use Regulations, including 2010 Flood Hazard Overlay District and 2013 Fluvial Erosion Hazard Overlay District regulations.
- Town of Warren Road Erosion Inventory Report, March 2018 by CVRPC.
- Annual Report of the Town of Warren and the Warren Town School District; Report years 2013-2017.
- Town of Warren Solid Fuel Burning Appliance Ordinance, effective 6/24/2016.
- Warren Alarm Ordinance of September 22, 2015.
- Flood Study Mad River Area, Towns of Fayston, Moretown, Waitsfield, Warren, and Waterbury Washington County Prepared for CVRPC by DuBois & King May 31, 2017.
- Basin 8-Winooski River Watershed Water Quality and Aquatic Habitat Assessment Report, VT ANR, DEC, Water Management Division, Monitoring Assessment and Planning Program, June 2017.
- Upper Mad River Corridor Plan January 31, 2008 prepared by Evan Fitzgerald, Fitzgerald Environmental Associates, LLC. and Lisa Godfrey, Geomorphologist, prepared for Friends of the Mad River.
- Fluvial Geomorphology Assessment of the Mad River Watershed, Vermont prepared for Friends of the Mad River by Field Geology Services, March 2007.
- Watershed Restoration and Resiliency Project, Mad River Valley, Vermont Stormwater Management Regulation in The Mad River Valley; Review and Recommendations, Final Report, April 2013, prepared for Friends of the Mad River by Watershed Consulting Associates, LLC.
- Mad River Valley 2017 Annual Data Report by the Mad River Valley Planning District.
- 2017 Mad River Valley Housing Study prepared by the Mad River Valley Planning District.
- Preliminary WORKING DRAFT April 2018, VT ANR, Watershed Management Division, Winooski River TACTICAL BASIN PLAN.
- Warren Local Emergency Operation Plan 2018.
- Warren 2018 Hazard Analysis Map.
- FEMA Local Mitigation Planning Handbook March 2013 and Local Planning Review Tool Guide.
- FEMA Reference Guide, Demonstrating Good Practices within Local Hazard Mitigation Plans, Region 1, Boston MA, May 2018.

- Warren Capital Improvement Budget
- Flood Ready Vermont website, community reports
- Federal Emergency Management Agency, Repetitive Losses/BCX Claims, Vermont; and Non-mitigated repetitive loss properties data; 2016 data base.
- FEMA Disaster Declarations in Vermont.
- National Weather Service.
- National Oceanic and Atmospheric Administration (NOAA), National Centers For Environmental Information and historical weather data.
- American Community Survey Demographic and Housing Estimates, 2011-2016 American Community Survey 5-Year Estimates.
- 2010 US Census Bureau.

The following chart provides an overview of Warren's 2012 local hazard mitigation actions along with their current status.

2012 Mitigation Action	2019 Status
Relocate a section of West Hill Road away from eroding stream bank	In 2013 a nailing grid application was done and town is watching to see if another application is needed. Town will not be relocating or moving the road. On 9/30/2017 – No movement was observed since last plan update.
Reface or replace the Covered Bridge abutment	Construction Funding has not been secured and project has become controversial. Historic Preservation matters have delayed implementation. This has been carried over into the next five year mitigation strategy.
Identify and become knowledgeable of non-compliant NFIP structures	Town is still interested in action and this is performed as a regular function of the ZA/FA as part of the enforcement of the Zoning regulations and Flood Hazard regulations. The Town adopted Fluvial Erosion Hazard Overlay regulations in 2013.
Replacement and upgrade of Kingsbury Bridge	completed
Obtain temporary bridges for Plunkton Road and perform engineering studies for upgraded replacements	completed

Expansion and upgrade of culverts on Golf Course Rd, Airport Rd, Fuller Hill Rd, and Plunkton Rd	Completed 2014 through 2017
Selected projects from Mad River Corridor Plan – see appendix	Completed as funds and town capacity allowed based on priority set by SB in conjunction with Road Foreman
Purchase and install generator for Town Garage	Completed
Purchase additional communication devices for Town DPW vehicles	Completed
Upgrade and reconfigure Volkstown Rd/Airport Rd Intersection	completed
Provide training to residents on how to insulate homes (pipes, attics) for extreme cold spells	completed
Upgrade electrical systems in municipal buildings and shelters to prevent surge/equipment damage from fluctuating current during ice and wind storms	completed
Develop and distribute public education materials about reducing wild fire risk	To be carried over into 2019 Plan
Work with elected officials, the State ANR and FEMA to correct existing compliance issues and prevent any future NFIP compliance issues through continuous communications, training and education	Ongoing. Town Zoning Administrator administers the Flood Hazard regulations and issues permits in accordance with the regulations and is responsible for seeking compliance. Warren in enrolled in the NFIP program and updated the flood hazard regulations in 2010 as part of compliance with the NFIP program. There are no enforcement actions for non-compliance at this time.

Existing Hazard Mitigation Programs, Projects & Activities

The ongoing or recently completed programs, projects and activities are listed by mitigation strategy and have occurred since the development of the previous plan and were reviewed by the planning team. They share and incorporate the overall goals of the local hazard mitigation plan. Warren has the capacity to maintain these programs and initiatives using town staff, community volunteers, and partnerships with local community organizations as described in the Community Capacities above. This will require the Town to fill the vacancies that exist in order to bring the town back up to 100% capacity relieving current staff and volunteers from filling the

gaps. Unless otherwise noted, there is no need to expand or improve on these programs, projects and activities.

It is important to note, the job of the Highway Foreman continues to evolve. There is an increasing need to spend more time with administrative duties of the job and coordinate with the Town Administrator. This is in part due to new requirements and regulations the town is subject to from Act 64 (the Clean Water Act) and the need of the Town to secure funding from both non-emergency and emergency grants which help to increase their capacity for implementation of mitigation strategies and actions. It is also due to the lack of a Public Works Director. The Town Road Foreman, Ray Weston, has the experience and ability to perform all roles however, hiring a Public Works Director will increase the capacity of the Highway Department to address new regulations, standards, and projects. The additional expectations placed on the Road Forman is a challenge the town recognizes going forward. Some of the more significant projects completed or awarded to protect roads and increase flood resiliency during the past five years are identified throughout this Plan.

Existing Hazard Mitigation Programs, Projects & Activities Table.

Community Preparedness Activities			
Activity	**Responsible Authority**	**Notes**	**Capability to Expand/Improve**
2018 Local Emergency Operations Plan (LEOP)	Warren Selectboard, EMD	Annual update occurs after Town Meeting Day and before May 1st. State will require new model for use in 2019.	Town will require training on new model to develop the 2019 plan. Trainings will be conducted by state VEM and CVRPC.
Certification in ICS 402 or 100	Warren Selectboard members and or Town Administrator	LEOP requires adoption by SB with certification by a member trained in ICS 402 or ICS100. VEM in collaboration with CVRPC holds trainings annually, especially from March – May.	Town maintains a minimum of one Selectboard member with earned certification. Town has the capacity to increase the number of SB/TA persons earning ICS402 or ICS100 certification.
VT ALERT participation sign up by residents	Warren Public Safety Department, Fire Chief, SB	Through Town website, residents are encouraged to participate and sign up for VT Alert.	No action is needed to expand this activity.
Capital Equipment Plan	Selectboard, Town Administrator, Town Treasurer, Road Forman/Public Works Director/Fire Dept.	Annually updated as part of Town Budget and planning process. Voted at Town Meeting. In 2018, CVRPC assisted Warren with update to the Capital Budget in an effort to help stabilize the town's tax rate.	Process is satisfactory; no need to expand or improve.

Warren School Emergency Action Plan (EAP)	Unified School District	VEM has a program for School Safety and assists schools in the development and exercising of their School Emergency Action Plan.	With the new unified school district, the EAP should be updated to reflect changes in district service area. VEM program is satisfactory to meet school needs
EOC established at Warren Municipal Building with secondary location at Warren Fire Department	Town Administrator, EMD, Warren Public Safety Dept., Selectboard, Town Clerk, Fire Chief	Pre-designated local emergency operation centers if activation is needed	Program is sufficient. Augmenting facility with additional tools and resources is prohibited by town budget.
3 Emergency Shelters	Sugarbush Jim Westhell; Selectboard, EMD, Warren Public Safety Dept.	Town Hall shelter does not have a backup generator.	Town has applied for funding to purchase and install a generator at Town Hall shelter. Capacity of Town Budget cannot fully support purchase & installation.
Participation at LEPC5 meetings (Local Emergency Planning Committee)	EMD	EMD participates at regular bimonthly meetings. He volunteers his time. Focus of LEPCs is on hazardous material facilities as defined by DPS and EPA.	No need to expand or improve on participation with LEPC 5.
Sugarbush Ski Area Emergency Action Plan	Sugarbush Resort with notification to Warren Public Safety Dept., Warren Fire Dept., EMD	Sugarbush Resort shares EAP with Warren First Responders.	No need to expand or improve on program
Appointment of Town Fire Warden to serve a five year term.	Mike Brodeur, Warren Forest Fire Warden, SB	Mike B. issues Burn Permits and has opportunity to train with and receive technical support from the VT Forest Parks, and Recreation Department.	Position is filled and there is no need to expand or improve on program. Town website provides contact information and burn permit information.
2015 Ordinance related to the use of alarm systems – all alarms must be registered with the Town of Warren	Board of Selectman, Planning Commission, Warren Fire Department	In response to request by Fire Department to reduce Number of false alarms and have contact data on record.	No need to expand regulation. Need time to observe and track effectiveness.
No burn of solid fuel appliance ordinance	Board of Selectman, Planning Commission, Warren Fire Department	In response to fires at Sugarbush resort condominiums and State of VT order.	No need to expand ordinance. Need time to observe and track effectiveness.
E911 Service area maps created by CVRPC	Warren Public Safety Department, Assistant Fire Chief	Maps created at EMD request to help assist emergency responders	No need to expand program
Tier II facility summaries and maps by CVRPC	EMD, Town Administrator	Previously work was done using EMPG & SERC funds.	As of 2018, EMPG will no longer fund Tier II activities.

Hazard Control and Protection of Critical Infrastructure and Facilities			
Activity	**Responsible Authority**	**Notes**	**Capability to Expand/Improve**
Maintenance Programs (Culvert, Road and Bridge Survey); Warren Hydrologically Connected Roads Inventory	Road Foreman/Public Works Director, Selectboard	Warren works with the CVRPC to schedule and perform routine culvert surveys about every 3-5 years. Last culvert inventory was completed in 2018. Warren serves on the region's Transportation Advisory Committee (TAC). Warren has a Municipal Roads General Permit. Town staff is trained to use digital application for road erosion inventory.	As part of the Warren MRGP, CVRPC completed the Road Erosion Inventory in 2017 and issued an initial report in early 2018 identifying priority road segments and a draft schedule for mitigation implementation. No need to expand on program. Vermont Clean Water Act (Act 64) has increased standards and regulations towns must now meet. Warren will require grants to implement measures. Town has capacity with support of CVRPC to apply for grant funding.
VT AOT Codes and Standards for Roads and Bridges, 2/18/2014	Selectboard, Road Foreman, Public Works Director (PWD)	Warren has adopted the State Standards and follows them	No need for expansion or improvement. Town tracks Identification of eligible roads for Grants in Aid construction funds and managed those funds.
2002 Bridge Study	Selectboard, Road Foreman, Town Administrator	Recommendations for corrective action for the Covered Bridge.	Implementation of corrective actions are dependent upon funding, permitting, and political will.
Main Street Improvement Project 2017	Selectboard, Public Works Department, Town Administrator	Stormwater, drainage, and flood project	Completed in 2017; further work on parking area planned over next two years pending town funding and capacity.
Dry Hydrant Program - expanding its fire suppression system.	Selectboard, Fire Department	Town has a dry hydrant program and works with the VACD Rural Fire Protection Program (formerly the Dry Hydrant Grant Program) to establish developed sites in town.	VACD RFPP provides technical expertise and grant funding that is accessible to the town. No need to expand on the program.

Wastewater Treatment EAP	SB, Town Administrator/Wastewater Coordinator	Town complies with state regulations for treatment facility.	No need for expansion or improvement; plan reviewed annually and updated in accordance with state statute.
Village Water Supply System 2017	SB, Town Administrator		New system; no need for expansion or improvement
Solar array in 2014	Selectboard, Warren Energy Committee, Warren Elementary School Board	522 solar panel array provides all the power for the Warren Elementary School and part of the town buildings in the village. This effort reduces the town's carbon footprint helping reduce climate impacts.	No action needed to expand or improve program
2015 Energy efficiency measures	Selectboard	Town Hall and Fire Department heating system upgrades; Municipal offices upgrades to the hot air system. Reducing vulnerability of critical facilities.	No need to expand on project
Stone line ditch initiative to meet changes in VT codes and Standards for all ditches with slopes >5%	Road Foreman/PWD, Selectboard	Warren has made improvements to several roads as noted in the Warren Annual Reports	Program is ongoing as funds and town capacity allow.
Capital Reserve Fund maintained to fund projects	Selectboard	Annually approved by voters at Town Meeting	No need to expand or improve process
Ridge to River Task Force member	Selectboard, PC	Developing Stormwater Master Plan; focus on resiliency and reduction in impact/damage to infrastructure from flood	Town is an active member and recipient of project initiatives and programs. No need to expand on program.
Friends of the Mad River member	Selectboard, PC	FMR has initiated several studies, projects, and educational programs to mitigate the hazard of flood. These activities are mentioned throughout this Plan.	Town is an active member and recipient of project initiatives and programs. No need to expand on program. Town will continue to support ongoing projects and see projects to completion.
Mutual Aid Response agreement with surrounding communities	Selectboard, Warren Public Safety Department, Warren Fire Department	Warren is a member of mutual aid systems Washington counties, working alongside	No need for expansion or improvement.

		Waitsfield, Moretown and Fayston Fire Departments.	
Forest Development Road Cooperative Agreement Green Mountain National Forest	Selectboard	Use and maintenance of road system within the national forest.	Agreement has been in place since 1968 between Warren and the USDA Forest Service. No need to expand or improve.
Highway Equipment and Personnel Mutual Aid Agreement	Selectboards and Highway Road Commissioner/PWD of Warren, Waitsfield, Fayston, and Granville	Towns agree to combine resources and experts in time of emergency situations such as hurricanes and floods and provide mutual aid in the form of highway equipment and personnel.	2012 agreement reviewed annually; no need to expand policy
Warren Local Hazard Mitigation Plan 2019 update	Selectboard, Town Administrator, LHMP committee	Plan effective for 5 years. In process of updating adopted 2012 LHMP to meet FEMA standards. Once the updated 2019 Plan is adopted and FEMA approved it will be reviewed annually and after every disaster event with a full update in 5 years prior to its expiration.	Town is in process of update with support from CVRPC. Town will need to receive VEM and FEMA approval prior to adoption of this Plan.
Riparian Tree Planting	FMR, volunteers	Promotes stabilization of bank and limits erosion and helps with storm water management and flood hazard.	Ongoing work continues with FMR and RTR task force as grant funding and capacity allows.

Land Use Planning and Management			
Activity	**Responsible Authority**	**Notes**	**Capability to Expand/Improve**
Warren Land Use and Development Regulations	Planning Commission, Selectboard	Updated in 2010 Flood Hazard Overlay District; 2013 established Fluvial Erosion Hazard Overlay District; 50 feet naturally vegetated buffer maintained of surface water; review of any development within 100 feet of surface water.	No need to expand
Subdivision-PRD PUD-App.01.13	Planning Commission, Design Review Board, Selectboard		No need to expand
Interim River Corridor Regulations	Planning Commission, Selectboard	ANR has developed model ordinances and state is in the process of completing mapping	Consider adoption of river corridor regulations with state phase II mapping to maintain ERAF rating
Road Access Permit	Selectboard, Road Foreman.		No need to expand
Geomorphic Fluvial Assessment in 2007	Selectboard		No need to expand. Use as a planning resource.
Upper River Corridor Plan, January 2008	Selectboard		No need to expand. Use as a planning resource
Mad River Resource Management Alliance	Selectboard	Town participates in alliance for solid waste disposal; alliance holds special hazardous waste collection days	No need to expand program. Town pays fee and it is part of the town's annual budget.
MOU with MRV towns, Sugarbush, CVRPC, State of VT	Parties to the MOU	Phases any expansion at Sugarbush to be compatible with MRV capacity to accommodate the expansion and growth.	MOU in effect since 1983 no need to expand, parties have option to amend as necessary.
2017 Mad River Valley River Study by D&K	CVRPC, Selectboard	Final report can be used for further engineering study of floodway delineation for request of amendments to FEMA flood boundary maps.	Expansion of study dependent upon funding and town capacity and political will.
2014 drafted an overarching management plan for the town-owned floodplain properties along the Mad River	Conservation Commission, Selectboard.	Riverside Park, Rewinski FEMA buyout, Aldeborgh /Roe parcel southwest of Kingsbury Bridge	Implementation of management plan is contingent on town capacity and funding.
Traffic Ordinance	Selectboard		No need to expand.

2018 Storm Water Master Plan	Selectboard, CVRPC, FMR	In process; 5 Mad River Valley towns.	Work is being performed under a grant.
27,392 acres of land, private and public, under conservation or open space management and natural resource protection. These lands include the National Forest Service, town forests, family farms, productive forestlands, and riparian lands.	Selectboard, Conservation Commission, Recreation Committee, Landowners, state and federal government.	These efforts contribute to the community's overall resiliency and reduce the vulnerability to hazards	Programs and policy in place; no need to expand on program/policies.
FMR 2008 Mad River Corridor management Plan (Waitsfield/Warren)	FMR, Selectboard		A planning resource; no need for expansion.
Warren 2008 Natural Heritage Inventory and Assessment with subsequent studies	Selectboard, Conservation Commission		No need to expand. Use as a planning resource
2015 scoping study of pedestrian pathways for upper Access Road partnership with Mad River Path.	Selectboard, Conservation Commission, Recreation Committee, Mad River Path		No need to expand. Use as a planning resource
2014 Wildlife Corridor Field Analysis	Selectboard, Conservation Commission		No need to expand. Use as a planning resource
2016 Warren Corridor Conservation Area: Ecological Inventory and Assessment	Selectboard, Conservation Commission		No need to expand. Use as a planning resource
2017 Warren Corridor Conservation Area: Wildlife Movement Patterns and Use Recommendations	Selectboard, Conservation Commission		No need to expand. Use as a planning resource
FMR Tree planting grant from US Fish and Wildlife Service south bank of Riverside Park to help area function better as a floodplain.	Selectboard, Friends of the Mad River, River to Ridge task force, Conservation Commission, resident volunteers	Implementation of recommended floodplain management practices	Work under grant is completed. Town may apply for other grant funds as opportunities arise or partner with existing organizations; no need to for further action.

Insurance Programs			
Activity	**Responsible Authority**	**Notes**	**Capability to Expand/Improve**
Participation in the National Flood Insurance Program	Selectboard, Flood Administrator/Zoning Administrator	Warren last updated the Flood Hazard Regulations in 2010 and enforces the regulations. It uses the most recent FEMA FIRMS for Warren. The Zoning Administrator serves as the Flood Administrator	Assistance is provided by ANR Floodplain Manager and CVRPC as requested. Town's current Flood insurance rate Map was updated in 2013. No need to expand program.

Public Awareness, Training, and Education			
Activity	**Responsible Authority**	**Notes**	**Capability to Expand/Improve**
2018 Statewide Strategic Transportation Plan High Risk Rural Roads Program (now the Systemic Local Road Safety Program)	Selectboard, AOT	VTrans study on the Access Road; installation of new signs, pavement markings and guardrail on high risk rural roads	Part of a state phased study and implementation project. AOT funded. No need for town to expand program.
CPR Trainings	Mad River Valley Ambulance Service, Warren Public Safety Department		Offered as needed; no need to expand program
School Fire Safety Program	Warren Fire Department		Ongoing action; No need to expand program
Public awareness road safety signs	Selectboard, Public Works		Ongoing program no need for expansion
Winter Road Maintenance policy	Selectboard, Town Administrator, Road Foreman, PW Director	Reviewed annually	No need for expansion. Amended annually as necessary.
VTrans Winter Road Brochure	Town Administrator, Town Clerk	Available at town offices and via AOT website	No need to expand program
2018 newly redesigned website and webpage	Selectboard, Town Clerk	Town posts educational materials, notices and general town government information on the website, including notices to sign up for VTAlert.	Recently updated. No further action necessary.
Safe Routes to School Program	Selectboard, Road Foreman, school principal	This is an VT AOT Transportation Planning initiative task.	Comes under TPI program the Town participates in with the CVRPC; no need to expand program.
Mad River Valley Television, Front Porch Forum, Valley Reporter, postings around town	All	Warren uses a variety of media to communicate with the public.	No need to expand forms of communication.

4.3 Plan Maintenance Process

Over the next five years, the Town will continue to review and evaluate this Plan's assessment of vulnerability, adhere to its maintenance schedule, as best as it can, and begin implementing, when possible, the mitigation actions proposed in this Plan. Monitoring of plan progress and implementation will be undertaken by the Town Administrator and Select Board with support from the Local Hazard Mitigation Planning Committee (LHMP Committee). Monitoring updates may include changes in community mitigation strategies; new town bylaws, zoning and planning strategies; progress of implementation of initiatives and projects; effectiveness of implemented projects or initiatives; and evaluation of challenges and opportunities. The plan is to be a "living document" to allow for new actions to be identified in the five year interim period and amended without formal re-adoption during regularly scheduled Select Board meetings. Prior to the end of the five year period, the plan will be undergo a formal update and submitted to FEMA for re-adoption following the process outlined in the schematic found in the Attachments section of this Plan. It is recommended, in order to maintain a current and up to date unexpired Plan, to begin the plan update process with FEFMA within one year of this Plan expiration date. The town may use the mitigation action tracking sheet (see template in attachment section of Plan) or similar method to assist with progress reporting on the mitigation actions and strategies taken over the next five years.

The Warren Local Hazard Mitigation Plan will be updated and evaluated annually at a March Select Board meeting of their choice to discuss and evaluate the Plans effectiveness. The Local Hazard Mitigation Planning Committee will present recommended updates to the board at this meeting. The Local Emergency Management Plan (formerly known as the LEOP) will also be reviewed at this time. Updates and evaluation by the Select Board will also occur within three months after every federal disaster declaration and as updates to town plan/zoning and river corridor plans come into effect. The Plan will be reviewed by the Select Board, Town Administrator, LHMP Committee, and public at the above-mentioned March Selectboard meeting. CVRPC will help with updates or if no funding is available, the Town Administrator and the LHMP Committee will update the plan. In addition, the LHMP Committee will provide updates at all future Annual Town Meetings or in a report for inclusion in the Annual Report of the Town of Warren, through December 31, of a given year.

The process of evaluating and updating the plan will include continued public participation through public notices posted on the municipal website, notice in the municipal building, Valley Reporter and Mad River Valley Television, inviting the public to the scheduled Select Board (or specially scheduled) meeting. Additional stakeholders invited to the meeting will be Sugarbush, business owners in the Village, and the directors of Friends of the Mad River and the Mad River Valley Planning District. Also invited in the future will be the VT Agency of Natural Resources (VT ANR), as they are able to provide assistance with NFIP outreach activities, models for stricter floodplain zoning regulations, delineation of fluvial erosion hazard areas, and other applicable initiatives. These efforts will be coordinated by the Town Administrator.

Warren shall also incorporate mitigation planning into their long term land use and development planning documents. It is recommended the Town review and incorporate elements of the Local

Hazard Mitigation Plan when updating the municipal plan, zoning regulations, flood hazard/FEH bylaws, Municipal Roads General Permit, and Stormwater Master Plan. The incorporation of the Local Hazard Mitigation Plan into the municipal plan, Land Use and Development Regulations, Municipal Roads General Permit, and Stormwater Master Plan will also be considered after declared or local disasters. The Town shall also consider reviewing future Mad River Corridor planning documents, initiatives of Ridge to River task force and Friends of the Mad River, and studies and planning documents of the CVRPC and MRVPD for ideas on future mitigation projects and hazard areas.

In 2013, the Vermont Legislature passed a law requiring all towns to incorporate a flood resiliency element into their municipal plan as of July 2014. As part of meeting this requirement, Warren will identify flood hazard and fluvial erosion hazards, strategies, and recommendations to mitigate risks to public safety, critical infrastructure, historic structures, and public investments. This Plan will help Warren comply with the new community flood resilience requirements for Municipal Plans adopted after July 2014.

5. Community Vulnerability by Hazard

5.1 Hazard Identification and Risk Analysis

The following natural and man-made disasters were discussed and the most significant threat hazards were identified based upon two methodologies used by the LHMP Committee. The most significant hazards identified will be the focus of this Plan. Hazards not identified and discussed in this Plan may still occur, they are just not the focus of this Plan. Greater explanations and mitigation strategies of these hazards can be found in the State of Vermont's Hazard Mitigation Plan.

The risk analysis and assessment for this Plan update provides a more in depth analysis and assessment than that used in 2012 which focused on probability of occurrence and whether or not the hazard posed a threat. In performing this hazard analysis and risk assessment, the LHMP Committee first looked at the potential impacts of identified hazards including frequency of occurrence, infrastructure impacts, life safety issues, economic impacts, and environmental impacts and then assessed the town's level of concern for the hazard. A summary of the committee's findings can be found in the tables that follow.

Although the Town cannot predict the future, recent changes in Vermont's climate have made old weather patterns less predictable and Warren has seen an increase in the number and severity of storms, especially high intensity rainfall events along with milder winters. In response to the changes in the weather patterns, Warren has redefined "Hurricane/Severe Storms" identified in the 2012 plan, to the hazard category of Severe Thunderstorms/Thunderstorm Winds/High Winds in this Plan which more accurately reflects the hazard now and likely to continue into the next five years. In addition, the 2012 focus of severe winter weather (winter storm/ice storm/extreme cold) will now be on ice storms and snow events equal to or greater than eighteen inches. Flood has a history of a high probability of occurrence and causing significant damages in Warren. At least one flood event each year over the past five years has

occurred, often resulting in a federally declared disaster, keeping flood as the most significant hazard threat for Warren.

Those hazards not found to pose the greatest threat to Warren such as avalanches, bird flu, cyber-attacks, dam failures, drought, dust storm, earthquakes, extreme heat, extreme cold, hail, hazard material spills, hurricanes, tropical storms, ice jams, invasive species, infectious diseases, infrastructure failures, landslides/debris flows, lightning, long-term power outages, transportation spills, terrorism, tornadoes, and water supply contamination are not addressed in this Plan due to low probability of impact or negligible potential impact and scarce community resources (time and money). A review of the Vermont State Hazard Mitigation Plan of November 2013 provides a greater explanation of these hazards and possible mitigation strategies to address them. Like the State of Vermont Hazard Mitigation Plan, Warren did not include the following hazards in the risk and vulnerability assessment due to the low occurrence, low vulnerability, and or geographic proximity: civil disturbance, coastal erosion, expansive soils, karst topography, subsidence/sinkholes, tsunami, and volcano. The Hazard Assessment Table reflects the hazards Warren feels can be expected, or at least are possible, to occur in Town and are identified by the State of Vermont.

Hazard Risk Assessment Summary Table:

Identified Hazard (natural & man-made)	**Potential Impacts**					**Total:** (Columns 2-5)	**Level of Concern**
	Frequency of Occurrence: Probability	Infrastructure Impacts:	Life Safety Issues:	Economic Impacts:	Environmental Impacts:		
Avalanche	2	1	2	1	1.5	7.5	Not very concerned
Bird flu	1	3	1	1	2	8	Neutral
Cyber Attack	2	1	1	1	1	6	Neutral
Dam Failure	1	1	1	1	2	6	Very concerned
Drought	3	3	2	3	3	14	Neutral
Dust Storm	1	1	1	1	2.5	6.5	Not very concerned/Not concerned
Earthquake	1	1	2	2	3	9	Neutral
Erosion	**4**	**4**	**2**	**4**	**3**	**17**	**Very Concerned**
Expansive Soils	1	1	1	2	1	6	Not concerned
Extreme Cold	4	3	2	2	2	13	Somewhat concerned
Extreme Heat	4	2	2	2	2	12	Somewhat concerned
Flood (flash flooding, flood inundation, fluvial erosion)	**4**	**4**	**2**	**4**	**3**	**17**	**Very concerned**

Identified Hazard (natural & man-made)	**Potential Impacts**					**Total:** (Columns 2-5)	**Level of Concern**
	Frequency of Occurrence: Probability	Infrastructure Impacts:	Life Safety Issues:	Economic Impacts	Environmental Impacts:		
Hail	2	1	1	1	1	6	Somewhat concerned
HazMat Spill/Release	2	2	2	2	4	12	Very concerned
High Winds	**4**	**3**	**2**	**3**	**2.5**	**14.5**	**Somewhat concerned**
Hurricanes/ Tropical Storms	2	3	2	3	3	13	Somewhat concerned
Ice Jam	1	1	1	1	3	7	Neutral
Invasive Species	4	3	1	3	3	14	Somewhat concerned
Infectious Disease	3	3	3	3	3	15	Somewhat concerned
Infrastructure failure	2.5	1	1	2	2	8.5	Somewhat concerned
Landslides/Debris Flow	2	1	1	1	2	7	Very Concerned
Lightning	4	1	2	1	1	9	Not very concerned
Long Term Power Outage	3	2	1.5	2	1.5	10	Somewhat concerned
Severe Thunderstorm/ Thunderstorm Winds	**4**	**3**	**2**	**3**	**2.5**	**14.5**	**Very concerned**
Ice storm	**4**	**3**	**2**	**3**	**3**	**15**	**Very concerned**
Snow storm = or >18 inches	**4**	**1**	**1**	**2**	**2**	**10**	**Very concerned**
Structure Fire	**4**	**2**	**3**	**2**	**2**	**13**	**Very Concerned**
Subsidence	1	1	1	2	1	6	Not concerned
Terrorism	2	1	1	1	1	6	Neutral
Tornado	2	2	1	2	2.5	9.5	Somewhat concerned
Transportation Spill	2	2	2	2	4	12	Somewhat concerned
Water Supply Contamination	1	2	1	2	3.5	9.5	Somewhat concerned
Wildfire	**3**	**3**	**3**	**3**	**4**	**16**	**Somewhat concerned**
Winter Storm	4	1	2	2	2	11	Somewhat concerned

DEFINITIONS OF POTENTIAL IMPACTS

FREQUENCY OF OCCURRENCE: PROBABILITY

- 1—Unlikely: <1% probability of occurrence per year
- 2—Occasionally: 1–10% probability of occurrence per year, or at least one chance in next 100 years
- 3—Likely: >10% but <75% probability per year, at least 1 chance in next 10 years
- 4—Highly Likely: >75% probability in a year

INFRASTRUCTURE IMPACTS: (Effects on Roads, Bridges, Structures, Homes)

- 1—Minor: Localized/Isolated impacts to Infrastructure (Temporary loss of use)
- 2—Moderate: Neighborhood level impacts (1-2 day loss of use)
- 3—Severe: Community-wide impacts (2-5 day Loss of use)
- 4—Disastrous: Regional losses of roads, bridges, homes (Extensive replacement/rebuild)

LIFE SAFETY ISSUES: (Health and Welfare of Population)

- 1—Minor scrapes/injuries
- 2—Occasional Hospitalization required due to injuries
- 3—Multiple hospitalizations required and/or fatality
- 4—Community-wide hospitalizations and/or fatalities

ECONOMIC IMPACTS: (Direct recovery costs to municipality and residents)

- 1— < $10,000 in damages (Can generally be handled within budget or via insurance)
- 2—$10,000-$100,000 (May require assistance for the uninsured or large impact on local budget)
- 3—$100,000-$1,000,000 (Requests of assistance/FEMA eligible)
- 4— > $1,000,000- (All resources used, Possible National Guard use)

ENVIRONMENTAL IMPACTS: (Effects to municipal operations and environment)

- 1 – Negligible: Short term impacts, low clean-up costs for spills
- 2 – Minor: Moderate clean-up costs, temporary redirection of municipal resources
- 3 – Moderate: Extended redirection of local resources/ impacts to normal operations, high clean-up costs
- 4 – Major: Long-term recovery efforts (could take years for full recovery or permanent loss of use)

A summary of the discussion regarding the level of concern follows. Not all high levels of concern resulted in a significant hazard classification due to considerations given to the various potential impact factors and as noted below.

Hazard Risk Assessment Level of Concern Summary

HAZARD	Level of Concern	Assessment of Town Vulnerability
Avalanche	Not very concerned	The committee felt the level of risk and damage is more to property and minimal to people.
Bird Flu	Neutral	There is educational awareness, but no specific cases related to Warren have been documented.
Dam Failure -Beaver	Very concerned	Warren owns a Class One Hazardous Dam (Blueberry Lake) and there is one privately owned manmade pond/dam Fuller Hill Shashouia. Regular inspections by the State and routine maintenance occur. Maintenance measures have been discussed with the private landowner and some have been implemented. Town has agreement with landowner to maintain a low water level and measures are taken to keep beaver out. The Fire Department is working with the landowner to establish a dry hydrant for fire department use. Dam/pond is a concern but town is working with the landowner to address the matter. This hazard is not the focus of this Plan.
Drought	Neutral	If the whole state of VT was under a drought this would be more of a concern. This is driven by the weather factor and could cause grass/forest fires. 84.9% of Warren is forested. Road dust would become an issue during drought conditions.
Dust storm	not concerned	Warren is surrounded by Mountains of green trees and luscious vegetation.
Earthquake	Neutral	Earthquakes in VT are rare and Warren does not experience them due to its geographic area. The last Earthquake that was close was in New York.
Erosion	Very concerned	Erosion is occurring due to the increasing weather patterns of isolated heavy rains/down pours causing road washouts, driveway washouts, and stormwater issues. Within the last few years the Town has experienced more frequent severe storms. FMR has an initiative to educate homeowners and landowners of stormwater management strategies; Slow it, Spread it, Sink it. Erosion and heavy rains will be addressed under the hazard category of Severe Thunderstorms.
Expansive Soils	Not Concerned	This is not applicable to Warren due to the natural surrounding terrain.
Extreme Cold	Somewhat concerned	The town has established places for sheltering to keep persons from the cold: Warren Fire Station, Sugarbush Ski Resort, and Warren Town Hall.

Extreme Heat	Somewhat concerned	The committee clarified that extreme heat is 4 or more days of heat over 100 degrees. In recent years, there has been only a week out of the summer that the committee could remember. *During the development of this Plan update, Warren (and all of VT) experience a record breaking heat wave from 6/29/18 -7/6/18 with temperatures in the 90's and a heat index above 100 degrees.*
Flood (flash flood, flood inundation, flooding)	very concerned	The town experiences flood events on a regular basis. Some significant ones such as the 98 floods, Tropical Storm Irene 2011, and the June/July rainstorms of 2013 and 2017. The town has been very proactive in preparing its infrastructure for these events thereby minimizing flood damage. Flood remains a significant frequent hazard threat to the community and is the focus of this Plan.
Fluvial Erosion	Very concerned	Being proactive, the Town passed Fluvial Erosion Hazard regulations in 2013 as part of town's zoning, preventing any building within the Flood Fluvial Erosion Hazard Area. In addition, Warren has done some FEMA buyouts. Fluvial erosion remains a significant hazard threat to Warren.
Hail	Somewhat concerned	Concern is more for personal property and local farmers. VT Ag. Dept. has programs to help farmers.
Hurricane/Tropical Storm	Somewhat concerned	The Town has only experienced one Tropical storm in recent history in 2011, prior to that the last TS was in 1999. Concern is with the associated flooding impacts and high wind damages.
Ice Jams	Neutral	Most of the Ice Jams have been down stream of Warren and have never impacted Warren.
Invasive Species (Emerald Ash Borer)	Somewhat concerned	Committee considered this threat but the town does not have the capacity to focus on it. The FMR and RTR with volunteers are addressing the issue of knot weed in the Mad River. Further evaluation of the forested lands in Warren is needed to determine if the Emerald Ash Borer is present and if there is a need for concern. About 50% of Warren is National Forest and private land. If Emerald Ash Borer is found in Warren it would impact the now dense vegetative cover and effect all areas of the social, economic, and natural sectors. This may be considered a hazard threat in the next plan update if more information is known for Warren specifically.
Landslide/Debris Flow	Very concerned	The Town has experienced a few landslides (Slide Brook, Lincoln Mountain). The town has been proactive in those areas using new technology with success; soil and nail grids to stabilize the slopes prior to and after. Town lacks the capacity, funding and does not own the land in 2 other areas where slides are occurring; one in the

		National Forest and one along Brook Road. These areas require ANR support and funding to address the matter and should be incorporated into the Winooski River Tactical Basin Plan. This is not a focus of this Plan.
Lighting	Not very concerned	There has been no occurrences of damage related to lightening associated with thunderstorms within the last 5 years or prior to that.
Severe Thunderstorms/ Thunderstorm Winds	Very concerned	The town experiences a high frequency of these storms resulting in road/bridge damages and power outages associated with the heavy erosive rains and high winds that accompany the storms. This is a significant hazard threat for Warren.
High Winds	somewhat concerned	Seems to be more localized along the high ridge lines. This hazard threat will be categorized with the severe Thunderstorms/thunderstorm winds.
Severe Winter Weather / Ice Storms	Very Concerned	Warren has experienced ice storms in the 1998 and 2015 storms, lost trees, power outages with more micro bursts. Winter storms are part of Vermont's normal weather and the town is equipped to handle a typical storm so they are only somewhat of a concern. However, ice storms are a high concern and are more often occurring as part of the Vermont winter weather. Winter Ice storms will be the focus of this Plan.
Subsidence (Sink holes)	Not concerned	Warren is not subject to this type of hazard due to its terrain and geology.
Tornado	Somewhat concerned	There has been no reported tornado's in Warren and Warren is surrounded by a mountainous layer.
Wild Fire	Somewhat concerned – Very Concerned	With the vast forested area which experiences a variety of uses and users year round, the opportunity and risk for a wildfire increases. As VT experiences changes in climate, the amount of dead and dying trees that are falling can fuel a wildfire. As more people explore and use the forests the potential for human error/cause of fire increases. Wildfire is a significant moderate hazard for Warren and is addressed in this plan.
Snow	Very Concerned	Warren is capable of handling the average snow fall but is vulnerable when storms are 18 inches or more taxing the labor and equipment force. A lack of snow hurts the local ski economy and limits the recharge ability of the groundwater table. Getting a lot of snow requires the town to provide safe roadways and the option to shelter persons if needed. A heavy snow year also means that much more water coming off the mountains in spring thaw conditions swelling waterways and storm drainage systems increasing the risk of flood hazard.

Man-Made Hazards/Disasters		
Hazardous Material Release/spill	Very concerned	Sugarbush Ski Area has a Waste Water Treatment plant and a Water Plant that receives regular deliveries of chlorine and aluminum sulfate. Anything that happens to the load in transport can result in water contamination, contaminated soils, ponds or anything below the spill containment area. In winter weather, The Town and Sugarbush have an established practice in place to reduce the risk of spill/release. Upon a call, the Town Highway Dept. will provide an escort by the Town plow and sand truck to the facility. This practice is in place and working. No spills in transport have occurred to date. Sugarbush files annual Tier II facility reports with Division of Public Safety, Warren Fire Department and the LEPC 5.
Infectious Disease Outbreak	Somewhat Concerned	The Center for Disease Control has protocols in place to protect public welfare. Trend is geographically located away from Warren. State laws are in place concerning vaccinations of children and the Dept. of Health is now addressing Lyme Disease. Strides in Modern Medicine are in the Town's favor.
Infrastructure Failures	Somewhat concerned	Bridges and buildings are inspected on a regular schedule and inventories are maintained. Town has a Capital Operations Budget and Capital Reserve Account to plan for scheduled replacement and improvement projects. MRGP also requires comprehensive road inventories and a Capital Plan.
Long Term Power Outages	Somewhat concerned	Based on weather patterns, the concern has risen but the Town has been proactive in installing generators at its critical facilities and shelters. Utility companies have made upgrades to the delivery system and maintain a line clearing program.
Structural Fire	Very concerned	Warren has an aging housing stock in the Sugarbush Area and the housing stock that was built in the 70's – 90's was built using sub code standards. The Town has been proactive enacting new ordinances and existing standards in Land Use and Development Regulations; such as housing structures requiring houses over 4000 sqf to have sprinkler systems, functioning and registered alarms in condo units, and no fuel burning appliances in condos and multifamily dwelling units, etc. Structure fires remain a significant hazard for the community and high concern of the fire department and state DPS. This is a moderate hazard identified in this Plan.
Transportation Spill	Somewhat concerned	Same as previously discussed with hazardous materials.
Terrorism	Somewhat concerned	Warren is concerned with what is happening around the world but feels it is beyond Warren's capacity.

Cyber attack	neutral	Potential is present.
Water Supply Contamination	Somewhat concerned	The water supplies at Sugarbush, the Town's municipal system that services its buildings, and the private wells, springs, and natural flowing water sources are susceptible to ground water contamination although the likelihood of contamination is low. The VT Dept. of Health requires annual water testing of public potable water supplies and the State regulates subsurface wastewater disposal systems with standards to protect groundwater and surface water.

The following hazards were found to be the priorities for the Town of Warren under this Plan:
Most Significant threat hazards:

Flood – (flash flood/flood inundation/fluvial erosion)
Severe Thunderstorms, Thunderstorm Winds, High Winds
Severe Winter weather defined as Ice storms and Snow storms = > 18 inches of snow/storm event)

Moderate Threat Hazards Include:

Structure Fires - (Condo's in particular; homes built in 1970's-1990's, Alpine Village)
Wildfire/Forest Fire

A discussion of the most significant and moderate threat hazards identified above is included in the proceeding subsections and a map identifying the location of each hazard is attached (See map titled *Areas of Local Concern/Hazard Analysis Map*). Each subsection includes a list of past occurrences based upon County-wide FEMA Disaster Declarations (DR-#) plus information from local records and the National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information (NCEI), formally the National Climate Data Center, a narrative description of the hazard and a hazard matrix containing the following overview information:

Hazard	Location	Vulnerability	Extent	Impact	Probability
Type of hazard	General areas within municipality which are vulnerable to the Identified hazard.	Types of structures impacted	Magnitude of hazard: Scale dependent on hazard	Dollar value or percentage of damages	Unlikely: <1% probability of occurrence per year Occasionally: 1–10% probability of occurrence per year, or at least one chance in next 100 years Likely: >10% but <75% probability per year, at least 1 chance in next 10 years

					Highly Likely: >75% probability in a year

5.2 Most Significant Threat Hazards

Flood - Flash Flooding/Inundation Flooding/Fluvial Erosion

Flooding is the overflowing of rivers, streams, drains and lakes due to excessive rain, rapid snow melt or ice. Flash flooding is a rapidly occurring flood event usually from excessive rain. Fluvial erosion is the process of natural stream channel adjustments. Fluvial erosion causes erosion of sediment in some areas, while causing aggradation of sediment in other. Fluvial erosion processes occur more quickly and severely during flood events.

History of Occurrences: The following chart indicates the history of occurrence with regard to flood hazard in Warren. Data is local, county-wide and state-wide. Specific data for Warren is limited or difficult to obtain. Since 1928, USGS has maintained a streamflow gauging station on the lower Mad River which records data at 15 minute intervals. The Mad River flood gauge is located in Moretown approximately 14 miles downstream and is north of the Village of Moretown. The other area flood gauges are Winooski gauge and Montpelier gauge. Where local data is available it is provided in the History of Occurrences chart. Federal declared disaster numbers are noted where applicable.

Data on the fluvial erosion damage in number of acres lost is not available for events and not included in the extent data. Warren has a history of experiencing gradual bank fluvial erosion which impacts the municipal transportation and infrastructure systems. A report was prepared for Friends of the Mad River in 2008 titled, Upper Mad River Corridor Plan January 31, 2008 prepared by Evan Fitzgerald, Fitzgerald Environmental Associates, LLC. and Lisa Godfrey, Geomorphologist. Past occurrences of fluvial erosion are documented in the 2008 River Corridor Plan for the Mad River. The Corridor Plan only identifies areas along the main stem of the Mad River and not erosion areas along Warren's tributaries. The plan does not identify the dates of past occurrences but does identify two areas in Warren (one area just upstream of the Covered Bridge and one area downstream of the Covered Bridge, totaling a length less than 200 feet) where the river banks are being affected by erosion.

Information to complete the history of occurrences was taken from the National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information (NCEI), formally the National Climate Data Center (NCDC), the FEMA Declared Disasters in Vermont data base, the State of Vermont Hazard Mitigation Plan dated November 2013, and town records.

Flood-Flash Flood/Inundation Flooding/Fluvial Erosion

History of Occurrences:

Date and Disaster Declaration Number if applicable	Event (By FEMA classification)	Location	Extent(measurement) and Impact, if known, ($ damages, # persons, other narrative)
7/17/2017	Flash flood	County wide	Heavy rain associated with scattered thunderstorm produced some isolated Flash Flooding. Scattered thunderstorms developed with a few containing large hail (> .75 inch in diameter) and some winds.
6/29/2017 – 7/1/2017 **DR 4330-VT**	Flood/Flash Flood, Severe Storm	Warren; Washington County	4-5" Rain; Heavy rains approx... 1-1.5 inches of rainfall on top of 3-4 inches of rain over a prior period of four days.
8/16/2016 – 8/17/2016	Flash Flood	Warren; Washington County	3 – 5 inches of rain in a few hours.
7/19/2015- 7/20/2015	Flash flood – heavy rain	Washington County	Storms traveling across the same areas over and over with torrential rainfall that lead to flash flooding in Barre & Plainfield. Thunderstorms with heavy rainfall repeatedly moved over northeast Washington County for several hours.
4/15/2014 – 4/18/2014 **DR 4178-VT**	Flood, Severe Storms	Warren; Mad River Valley, Washington County	Heavy rains & melting snow pack; widespread flooding; release of 4-6 inches of water from snowpack causing many waterways to reach near bankfull conditions across Central VT. Roads & bridges damaged. One culvert washed out in Warren.
6/25/2013- 7/11/2013 **DR 4140-VT**	Flood/Flash Flood/Fluvial Erosion, Severe Storms, heavy rain	Warren; Mad River Valley, Washington County	Numerous showers & thunderstorms with torrential, flooding rains across portions of VT. Rainfall rates of 2 inches/hour. **Mad River in Moretown crested at 9.33 feet above its flood stage of 9.0 feet on July 4.** Federal share obligated to Town of Warren for 7 projects was $35,136. Flash Flooding in southern Washington County transitioned to a flood event as flood waters moved downstream on the Mad River.

8/28/2011 **DR 4022-VT**	Flash Flood (Tropical Storm Irene)	Warren; Washington County; State wide	Mad River flood gauge at 19.07 feet; Montpelier Flood gauge at 19.05 feet (flood stage is at 15 feet); 3-5 inches rain Statewide with 5-7+ inches in Central VT. Flooding, flash flooding, fluvial erosion across Washington County VT. Winooski River primary river to flood in Washington County. WEC, Inc. & GMP customers without power for prolonged period of time (days). Federal share obligated to Town of Warren was $591,477.85 with 15 projects. Fluvial erosion extent data is unavailable
Date and Disaster Declaration Number if applicable	**Event (By FEMA classification)**	**Location**	**Extent(measurement) and Impact, if known, ($ damages, # persons, other narrative)**
5/20/2011 5/27/2011 **DR 1995-VT DR 4001-VT**	Flood/Flash Flood Severe Storm	Washington County, Warren	4" of rain, not a historical crest - Montpelier flood gauge at 17.59 feet, Winooski flood gauge at 423.3 feet. 3-5" plus of rainfall & severe flash flooding & resultant river flooding as well.
3/6/2011 and renewed flood ice jam on 3/11/2011	Flood; ice jams	Warren; Mad River Valley; Washington County	1-2" of rain followed by ~15" of snow and ¼ inch ice accumulation, early temperatures of ~ 40 degrees caused snow melt and river rise. Ice jam, ice flows, flooding of Mad River. Renewed flooding and ice jam of Mad River with additional rainfall of ¾ - 1 ¼ inches.
10/1/2010	Flood – heavy rain	Warren, Washington County	4-5" of rain, Mad River gauge at 10.39 feet. The Mad River created extensive flooding throughout the Mad River Valley. In Warren, a portion of the shoulder of Route 100 was damaged by the Mad River south of Warren Village.
8/2/2008 **DR 1790-VT**	Flash Flood	Washington County (Mad River Valley)	Mad River gauge at 7.89 feet – Heavy rainfall of several inches produced flash flooding.
3/15/2007	Flood; ice jams	Mad River Valley, Moretown Route 100B	Mad River Gauge at 13.5 ft; ¼ - ½ inch rain; 40 degree temps cause snow melt and river rise.
12/24/2003 **DR 1448-VT**	Flood	Mad River Valley	Mad River flood gauge at 14.17 feet
12/17/2000	Flood	Mad River Valley	3" of rain; no data for Mad River gauge
6/27/1998 **DR 1228-VT**	Flash Flood	Mad River Valley	3-6" of rain over 2 day period – Mad River flood gauge at 14.13 feet,
8/6/1995	Flood	Mad River Valley	Mad River flood gauge at 8.12 feet
3/31/1987	Flood	Mad River Valley	Mad River flood gauge at 11.97 feet
3/13/1977	Flood; ice jams	Mad River Valley	Mad River flood gauge at 13.72 feet
8/5/1976 **DR 518-VT**	Flood	County Wide	Mad River flood gauge at 13.47 feet
9/22/1938	Flood	County Wide	Mad River flood gauge at 16.34 feet

11/03/1927	Flood	County Wide	Mad River flood gauge at 19.40 feet

Flooding/flash flooding/fluvial erosion is Warren's most commonly recurring hazard. Flooding is the overflowing of rivers, streams, drains and lakes due to excessive rain, rapid snow melt or ice. Flash flooding is a rapidly occurring flood event usually from excessive rain. Fluvial erosion is the process of natural stream channel adjustments. Fluvial erosion causes erosion of sediment in some areas, while causing aggradation of sediment in others. Fluvial erosion processes occur more quickly and severely during flood events.
Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for flooding because rainfall that used to soak into the ground or take several days to reach a body of water now quickly runs off streets, parking lots and rooftops and through human-made channels and pipes. Over the past five years, stormwater management has become a focus of the flood resiliency efforts in the Warren community and a priority of the Ridge to River Task Force.

It is important to note that Vermont has experienced a majority of their flooding in areas along upland streams and in road drainage systems that do not adequately convey the amount of water they are receiving and these areas are not shown on the FEMA FIRMs. Flooding in these areas should be expected and planned for. The State of Vermont Hazard Mitigation plan states, "In recent years, flood intensity and severity appear to be increasing" and this continues to be supported by the trends and reports from the National Weather Service out of Burlington, VT. In Warren, flood occurring from intense rainstorms, severe storms, and snow melt are on the rise. Due to Warren's hilly topography, most flooding is of the flash flooding nature and often results in fluvial erosion rather than inundation flooding. Fluvial Erosion Hazard Zones extend beyond the NFIP floodplain and take into account the movement of a river channel. Warren adopted a Fluvial Erosion Hazard Overlay in 2013 to the town's zoning regulations. The town's flood hazard regulations incorporated into the local zoning regulations in 2010 are avoidance–based flood hazard bylaws that regulate development and fill in the Special Flood Hazard Area.

The Vermont Department of Environmental Conservation River Program is working to provide statewide coverage of fluvial erosion hazard (FEH) areas along the streams and river corridors. The river corridor is in the process of being delineated by the state for the larger streams and rivers and setbacks have been established for the smaller upland streams. This data is due to be released within the next year and will be a valuable tool for Warren in their efforts to help mitigate the risk of flash flooding. Once the statewide river corridor digital map layer is finalized it will facilitate mitigation and river corridor protection planning and prioritization. Warren has interim river corridor regulations and will need to adopt final river corridor regulations within two years of the state's data release. Model ordinances have been developed by the state for town's use. If funding is available and the political will exists, CVRPC can assist Warren in the development of a river corridor regulation that incorporates the Vermont mapped fluvial erosion areas.

As noted earlier, the village is located on the valley floor and flanked by the rugged steep slopes of the Green Mountains to the west and the Northfield range to the east. Many river and stream tributaries drain into the Mad River from the adjacent mountains. As in many New England towns, Warren built roads alongside mountain tributaries leaving them vulnerable to the hazard of flood and erosion.

The worst flooding event in Warren's recorded history occurred in 1927, followed closely by Tropical Storm Irene in 2011. The Mad River flood gauge readings during these events were 19.4 estimated and 19.07, respectively. Detailed historical records relating to the extent of the 1927 flood in Warren are not available, but were believed to be 2-3 feet higher than Irene; during Tropical Storm Irene, up to 4 feet of flooding occurred in basements in Warren Village. Warren received federally obligated funds in the amount of $591,447.85 for 15 projects for recovery efforts from Tropical Storm Irene.

Data gathered from the Mad River gauge by the Field Geology Services, shows the peak flows from 1927 – 2005 as depicted in the graph below; the 1927 Flood, the 1938 New England Hurricane, the 1973 Flood, Hurricane Belle, and the 1998 Flash flood. The Peak flows for the 1927 flood are estimated as the gauge was installed in 1928. Extensive damage throughout the valley occurred during these events. In the 2007 *Fluvial Geomorphology Assessment Report of the Mad River Watershed* prepared by Field Geology Services, reference is made to the fluvial erosion impacts from the two floods of the 1970's:

"... floods in the 1970's also caused extensive damage and led to increased channel management efforts (e.g., bank armoring and channel straightening) on the Mad River. The flood of 1973 caused extensive damage to infrastructure and agricultural lands in the lower watershed, and the recovery effort included bank armoring to arrest the resulting erosion. Three years later, the 1976 flood was of greater magnitude than the 1973 event, and resulted in significantly more areas of bank erosion and channel incision, likely due to the increased containment of flows within the channel following post-1973 bank armoring."

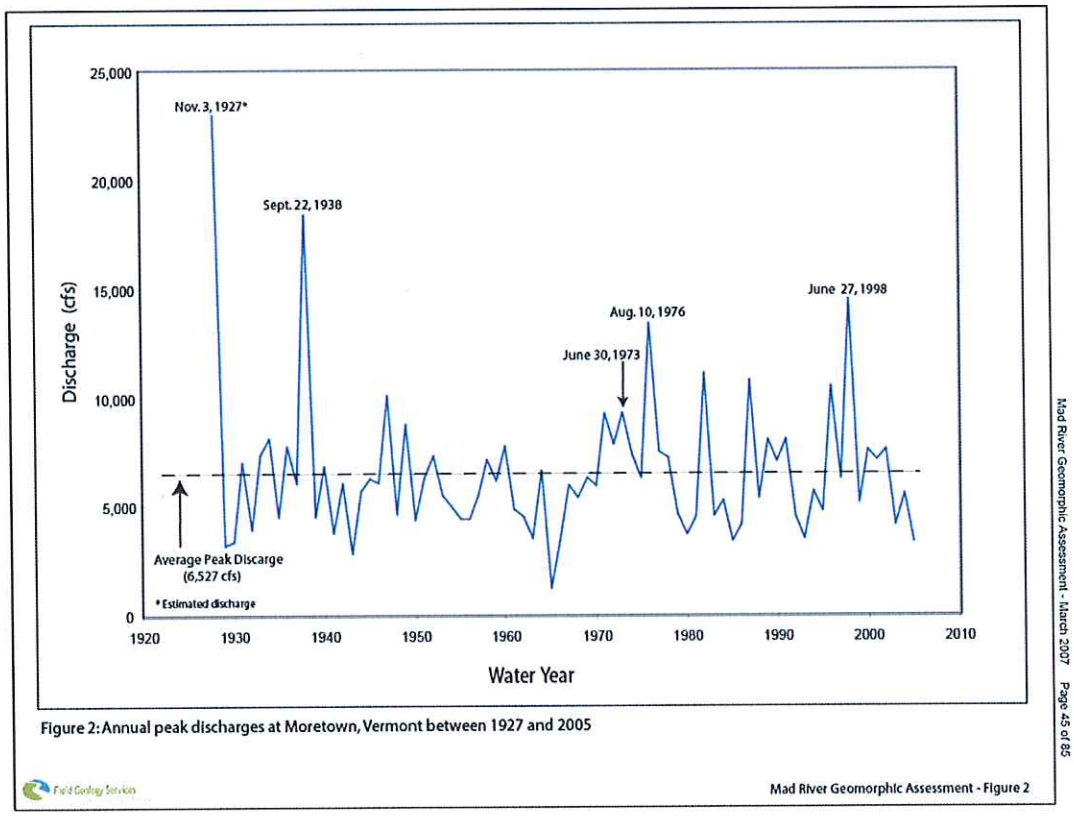


Figure 2: Annual peak discharges at Moretown, Vermont between 1927 and 2005

Mad River Geomorphic Assessment - Figure 2

Mad River Geomorphic Assessment - March 2007 Page 45 of 85

The 1998 flash flood, caused extensive damage and loss of property in Warren, destroying numerous homes by the flooding of the narrow valley through the Village. Estimates were above 17 million for damages to the Valley Area (The Valley Reporter, June/July 1998).

In the last five years, Warren has made significant upgrades and improvements to its road system and infrastructure. Through recovery efforts, regular maintenance, and special projects, Warren has become more flood resilient. Proposed projects over the next five years continue this effort and focus on Stormwater management which can help reduce the impact of flash flooding and erosion. The Town uses federal, local and state resources in order to have the capacity to perform the work, often in partnership with AOT, Friends of the Mad River, CVRPC and FEMA. Many of the larger projects are contracted out.

Warren has experienced a flood event at least once a year in the past five years that often results in a federally declared disaster. Under the most recent federally declared disaster in July 2017, DR 4330-VT, Warren received $31,815 to recover damages to the road and culverts of the Airport Road. Four culverts were replaced and improved during the July storm event, including the Highland Road culvert. Under the July 2013 federally declared disaster DR 4140-VT, Warren received $35,136 in federally obligated funds for 7 town projects. The following projects were completed: Senor Road ($15,140.55), Anne Burns ($2,429.84), Flat Iron ($1,402.30), Fuller Hill ($4,239.12), Prickley Mountain Road ($12,074.88), Behn Road ($8,431.94), and Plunkton Road ($3,129.96). In addition, Federal Highway roads included Lincoln Gap ($9,522.28) and Covered Bridge Road ($12,485). The Warren Elementary School parking lot sustained damage and washout from this intense rain storm too and required the town to replace the storm drain culvert and use erosion control measures. The Town applied for and received an Eco-Restoration grant in 2017 to further implement stormwater management practices for the Warren School Campus Parking Lot and will commence work under the grant award in 2018.

West Hill Road runs parallel to Bradley Brook and provides local access to rural residential development, the Sugarbush Golf Course and Sugarbush Ski Resort. Gradual bank erosion of the brook, aggravated by flood events, has impacted the stability of West Hill Road. In 2006 the road was closed for repairs and required local traffic to use alternative routes. One particular resident of West Hill Road requires frequent medical attention and the road closure extends the response time of emergency medical services. In 2015, the Town of Warren, hiring Geostabilization International, used a nail and grid system to geo-stabilize 90 linear feet at a cost of $126,000. Previously, it had geo-stabilized 200 linear feet of slumping section using soil and nails under road with steel mesh and grout over the area. Use of this new Geostabilization technology has been successful and replicated in other areas of town, including along the Sugarbush Access Road with the town being proactive by installing 5 nail and grid system, and on the Brook Road for 30 linear feet of soils and nails on slumping section near the Dump Road at a cost of $27,610. Additional improvements and upgrades were made to West Hill Road in 2016 under a 2015 AOT Better Back Road grant. Completed improvements included the installation of 7 new 18 inch culverts, 900 feet of drainage pipe with sock, ditch shaping with 200 cubic yards of stone lining, and hydro seeding (total cost $81,712). In 2015, the West Hill major culvert replacement and upgrade project was successfully completed at a cost of $274,000. The Bradley Brook culvert was replaced and upgrade using a natural bottom designed culvert for the passage of aquatic biota at any water level, a concept of US Fish and Wildlife Service. The other similar fish passage culvert replacement upgrade project took place on the Lincoln Gap Road at a cost of $160,929. The Friends of the Mad River and the Fish and Wildlife Services were partners in these projects and the Town contracted with Dubois Construction to perform the work. In 2018, the Town funded the complete bridge replacement of Bridge 24 on the West Hill Road at a cost of $375,000. In 2014, renovations included paving and the replacement of 16 culverts between Route 100 and Golf Course Road.

Fluvial erosion is also undermining the west abutment of the Village Covered Bridge. With more intense and frequent storm events, the area continues to be at risk and experience damage from flood and fluvial erosion. As stated in the Warren Town Plan the bridge is listed in the National

Register and was built following the 1927 flood. The 2002 Bridge Study indicates replacement of the western abutment is required and the River Corridor Plan recommends replacing and/or resizing the Covered Bridge Abutments. In 2014, the Town used a Transportation Enhancement Grant to fund the design plans for the western abutment replacement. In 2015, the Town applied for and received a Transportation Alternatives grant for $300,000.00 to fund the replacement of the western abutment, along with other renovations to the structure and downstream retaining wall, however, the total project is estimated at $750,000.00. More funding is needed for this project. In addition, concerns from the State of Vermont Historic Preservation/The Dam Preservation Trust/Friends of the Mad River have delayed this project, bringing it to a standstill due to the Timber Crib Dam and the historic preservation of the covered bridge.

After many years of concern and attempts to correct the problems with the 1929 iron Kingsbury Bridge that suffered from abutment degradation as a result of fluvial erosion and flooding, the Town and VTrans were able to address the problem together in 2013/2014. The bridge, spanning the Mad River along Route 100, is owned by the State of Vermont. In 2014, VTrans replaced the iron bridge with a pony truss bridge ensuring public safety.

Some of the other more significant projects the town has implemented to reduce flood risk and damage to town infrastructure involve the following road improvement and upgrade projects:

Golf Course Road (2017) - A major drainage project, including culvert upgrades and improvements. Culvert liner repair completed with outside contractor Kingsbury Construction, Road Foreman and Town Administrator.

Airport Road (2017) – Funds from a Better Back Road grant was used to rock line ditches, install drainage and fabric measures for erosion as identified in hydrologically connect roads map and by FMR. (2014) – Four new culverts installed on eastern end of roadway with road reclaimed and repaved. Lower section of roadway from Route 100 to top of steep grade had extensive gravelling, grading, culverts, paving and guardrails. Upper sectioned paved from four corners to the Dump Road.

Dump Road (2014) – Funds from a Better Back Road grant was used to install four 18 inch culverts, install drainage pipe with sock, shape ditches and line with stone and gravel and hydro seed. (2017) Pilot in Grant Program – used to pave areas to comply with the new VT storm water rules and to clean and stone line ditches (work done to point with Otter Lane). Also, two other areas, just above Otter Lane, were addressed with storm water management best practices.

Prickly Mountain Road – install four 18 inch culverts, install drain pipe with sock, shape ditches and line with stone and gravel.

Plunkton Road (2014)- Replacement of undersized culvert with upgraded corrugated steel pipe arch structure at lower end of roadway. Work by DuBois Construction.

Several Roads - cleaned and upgraded ditches, and improved with rock lining: Jones Road, Hanks Road, Airport Road, Plunkton road, Vickery Hill Road, Fuller Hill Road, Cider Hill Road, and others.

Sugarbush Access Road (2015) - Culvert replacement and upgrade, cold planning, top coat, and shoulder gravel.

Over the long term, improved storm water management and managing land use can help improve the health of the Mad River and reduce the flooding impacts of rain events. The Fuller Hill Stormwater project is a two phased project. Phase one was completed in 2017 with a feasibility study (assessment and design) under an Eco-Restoration grant. In 2108 the Town applied for a second Eco-Restoration grant for implementation (total project cost $118,874) to improve stormwater management on the lower reaches of Fuller Hill Road. This area of unpaved rural roadway contributes significant sedimentation and stormwater flow to the Mad River and the runoff poses a flooding and safety concern. If awarded, proposed implementation measures would reduce the flood risk and address one of the high priority roads identified in the Warren hydrologically connected road inventory. Other water erosion work performed on Fuller Hill road over the last five years included stone rock lined fabric ditches in the upper section in 2012 at a cost of $27,116.50 and two new culvert upgrades, underdrainage, ditching and stone lining to sections in 2015.

Warren has successfully used the Hazard Mitigation Grant Program to implement mitigation strategies to reduce its vulnerability to flood hazard. In 2016, a HMGP award of $4,720 was used to implement flood proofing strategies at the Pitcher Inn which has been prone to flood damage in the past. Recent buyouts over the past five years along the Mad River have also resulted in the restoration of the floodplain in those areas and using volunteers and Friends of the Mad River, riparian buffers were restored with tree plantings. In 2017, an HMGP award of $112,500 was used for the Mill Road Retaining Wall project. Project completion is expected in 2019/2020.

Warren has lessened the impacts and the town's vulnerability to flood hazard with mitigation activities and repairs done to its infrastructure. The Town Capital Reserve Fund, Town highway Budget, AOT grants, Federal and State assistance fund, Friends of the Mad River and Ridge to River Task force initiatives and funded projects, the recent completed hydrologically connected road inventory, and the 2018 culvert inventory are tools and resources that help Warren prioritize and implement their strategies. The Road Inventory Erosion survey and analysis positions the town to apply for grants for assistance in fixing some of its more challenging infrastructure needs.

The following matrix provides an overview of the flood hazard.

Flood Hazard Overview Matrix

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Flooding/ Flash	Areas of steep slopes/terrain,	Transportation	8/26/2011-9/2/2011	8/26-9/2/2011 $1 million for	Highly Likely

Flooding/ Fluvial Erosion	floodplain, areas where roads cross waterways, including bridges and culverts. Areas of most concern include: West Hill Road, Covered Bridge, Sugarbush Access Rd, Volkstown Rd, Plunkton Road, Warren Village, school & parking lot, Fuller Hill Road, Airport Road, Roxbury Mountain Road, Prickly Mountain Road.	Infrastructure, roads, bridges, culverts, and low lying roads. Private property, especially in floodplain and areas of steep terrain – 117 properties and 15 structures in the SFHA; 171 properties in the FEH area.	DR 4022-VT TS Irene - 5.75" of rain, Mad River flood gauge at 19.07 feet; 9 feet is flood stage. 6/25/2013-7/11/2013 DR 4140-VT Rainfall up to 2 inches per hour; Mad River gauge 18.33 feet. 6/29/2017-7/1/2017 DR 4330-VT 4-5 inches rain	Access Rd repairs, $350,000 from Irene damages, Federal share obligated to Warren was $591,478 for 15 projects. 6/25/2013-7/11/2013 Federal share of obligated funds $35,136 for 7 projects. 6/29-7/1/2017 $31,815 repairs to Airport Road and culverts.	

Severe Thunderstorms/Thunderstorm Winds/High Winds

A **severe thunderstorm** refers to a **thunderstorm** producing hail that is at least 1 inch in diameter or larger, and/or wind gusts of 58 mph or greater, and/or a tornado.

A severe **thunderstorm** warning (SAME code: SVR) is issued by the National Weather Service when trained **storm** spotters or Doppler weather radar indicate that a **thunderstorm** is producing or will soon produce dangerously large hail or high **winds**, capable of causing significant damage.

A **Wind** Advisory means that sustained **winds** of 30 mph for one hour and/or frequent gusts of at least 45 mph are occurring or expected within the next 36 hours. These **winds** will make it difficult to drive **high** profile vehicles. ... **Winds** this strong may damage trees, power lines and small structures.

History of Occurrences: The following chart indicates the history of occurrence with regard to Severe Thunderstorms/Thunderstorm Winds/High Winds hazard in Warren. Data is local, county-wide and state-wide. Specific data for Warren is limited or difficult to obtain. Where local

data is available it is provided in the History of Occurrences chart. Federal declared disaster numbers are noted where applicable. Information to complete the history of occurrences was taken from the National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information (NCEI), formally the National Climate Data Center (NCDC), the FEMA Declared Disasters in Vermont data base, the State of Vermont Hazard Mitigation Plan dated November 2013, and town records.

Severe Thunderstorms/Thunderstorm Winds/High Winds
History of Occurrence:
(Mad River Valley encompasses the towns of Waitsfield, Warren and Fayston)

Date and Disaster Declaration Number if applicable	Event (By FEMA classification)	Location	Extent(measurement) and Impact, if known, ($ damages, # persons, other narrative)
5/4/2018 – 5/5/2018	High winds / severe thunderstorm	County wide, Warren	Wind speeds in Central Vermont 37-46 mph. 1-2 inches rain in Washington County. Approximate wind speed 38 mph in Warren VT. Warren experienced minor impact with downed trees in roadways and scattered power outages
04/05/2018	High Winds/Severe Thunderstorms	Mad River Valley	Winds 40 -55 mph in Central Vermont; 1700 power outages, trees down across town; Hank Road and Sugarwoods Road in Warren closed temporarily due to downed lines and trees.
10/29/2017-10/30/2017 **DR-4356-VT**	High Winds & Heavy rain	County wide, State wide	Winds up to 63 mph. 51,300 customers statewide without power; Warren limited scattered power outages, and tree clearing
8/12/2017	Thunderstorm winds	County wide	Washington County winds 40-50 knots.
7/8/2017	Thunderstorm winds/heavy rain	County wide	Neighboring Duxbury winds at 50 knots, no wind speed data for Warren. Trees down

6/29/2017-7/1/2017	Severe Thunderstorms, heavy rains, strong winds	County wide; Mad River Valley; Warren	3 to 4 inches heavy rainfall in 3-4 days, then on 7/1/17, a series of heavy rain localized showers and thunderstorms moved across central VT causing scattered flash flooding. A few of these thunderstorms had strong winds to topple a few trees as well. Roads were also damaged throughout Middlesex, Duxbury, Northfield, Roxbury, and Warren. No wind speed data available. Airport Road in Warren washed out/Trees down. $20K damages.
7/19/2015-7/20/2015	Thunderstorm Wind	Warren; Washington County	50 knot winds. Several rounds of scattered thunderstorms; A few of these storms contained isolated damaging winds and hail up to one inch in diameter. Tree and large branches down on Airport road in Warren. The greater impact of these storms was the training of storms traveling across the same areas over and over with torrential rainfall that lead to flash flooding in Barre and Plainfield.
5/19/2015	Thunderstorm Winds	Warren; County wide	50 knot winds in Warren; trees down
7/18/2013	Isolated severe Thunderstorm, microburst	East Warren	50 knot winds; Brief wet microburst downed trees on several roads in/around Warren.
6/24/2013	Severe Thunderstorms/ Thunderstorm Winds	Mad River Valley	50 knot winds. Roads/Culverts Washed out; trees on powerlines along Route 100, trees down.

5/22/2013	Severe Thunderstorms	Mad River Valley	Roads Washed out; no town specific data.
8/28/2011 **DR 4022-VT**	Tropical Storm, Flash Flood (TS Irene)/heavy rain high winds	Warren; Washington County	Sustained winds 50 mph; Mad River flood gauge at 19.07 feet; 10.07 feet above flood stage (flood stage is 9 feet); 5-7 inches rainfall; federal share of obligation $591,478 for 15 projects
7/06/2011	Thunderstorm Winds	Washington County	50 knot winds; 15,000 people in VT lost power.
5/26/2011-5/27/2011 **DR 4001-VT**	Thunderstorms/Flash Flooding/Thunderstorm Winds	Warren; Washington County	Estimated 60 mph wind gusts; 1" hail, 25,000 customers lost power in VT, 3-5" of rain, not a historical Mad river crest
8/9/2010	Thunderstorm/Wind	Warren	50 knot winds; trees down
2/26/2010	High Wind	Statewide	Strong easterly winds of 80 to 100 mph along the peaks of the Vermont's Green Mountains and New Hampshire's White Mountains flowed downward across exposed higher terrain and western slope valleys with 45 to 60+ mph wind gusts. Numerous communities witnessed downed tree limbs. branches and some trees that resulted in downed power lines and power outages. Power outages in Vermont ranged from 20,000 to 40,000 customers.
7/21/2008-8/12/2008 **DR1790-VT**	Severe storm; Thunderstorm Winds	Warren, Statewide	50 knot winds; Several large branches downed by thunderstorm winds that fell on power lines in Warren. $5k property damage NOAA.
7/18/2008	Severe storm	Warren	30 knot winds and 1 inch size hail

6/10/2008	Thunderstorm Winds	Warren, Statewide	50 knot winds; scattered trees down across Warren. 15K property damages NOAA. In Vermont, hundreds to thousands of trees were damaged, downed or uprooted which caused downed power lines and structural damage to numerous buildings and vehicles. Tens of thousands of customers lost power due to the storms, with some outages that lasted several days.
7/9/2007 **DR 1715-VT**	Severe Thunderstorm	Mad River Valley	Baseball sized hail
8/2/2006	Thunderstorm Winds	Warren	50 knot winds. Some of these thunderstorms were locally severe and produced damaging winds that knocked down large tree branches and power lines in Warren. 3K property damages NOAA.
7/1/2006	Severe thunderstorms	Mad River Valley	Severe thunderstorms, 1" Hail
9/29/2005	Severe thunderstorms	Mad River Valley	Downed trees and power lines, 35 knot winds
6/23/2002	Thunderstorm Winds	Warren	Trees down; no magnitude data available
9/16/1999	Tropical Storm Floyd	Statewide	Tropical storm winds and flooding
7/22/1999	Severe thunderstorms	Mad River Valley	1.5" hail, severe t-storms
6/27/1998 **DR 1228**	Severe Storms	County Wide	Mad River gauge 14.13 ft
7/15/1997	Severe Storms	County Wide	3-5" of rain, Not a historical crest
5/19/1982	Thunderstorm winds	County Wide	56 knot winds
9/22/1938	Hurricane	Statewide	Category 1 force winds; Mad River Valley flood gauge at 16.34 feet

According to NOAA, severe weather is a destructive storm or weather that usually is applied to local, intense, and often damaging storms such as thunderstorms that must include winds of 58 mph (50 knots) or greater, hail storms one inch in diameter or greater, and tornadoes, but it can also describe more widespread events such as tropical systems, blizzards, nor'easters, and derechos. A thunderstorm wind equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½" is defined as approaching severe. The Town of Warren is most concerned with the severe thunderstorms, thunderstorm winds, and high winds associated with severe storms and the intense heavy rains often accompanying these storms that can create a flood hazard. These will be the focus for this Plan. Flood hazard is discussed in detail earlier on in this Plan.

Lightning produces thunder. Lightning is the electrical charges in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges builds up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning (as defined by NOAA). The discharge of electricity produces light (lightning) and sound (thunder). Lightning can kill, cause forest fires, and damage property. Warren has not experienced damage from lightning in the past five years and it is not identified as a priority hazard and therefore will not be discussed further in this Plan.

Thunderstorms, further defined in the Vermont State Hazard Mitigation Plan as follows, "Thunderstorms range in size and type. An ordinary cell thunderstorm consists of one cell with an updraft and downdraft and produce strong winds, rain, lightning, and even hailstones. Multicell cluster thunderstorms consist of several ordinary cell thunderstorms in the vicinity of each other. Multicell cluster thunderstorms are extremely prone to causing flash flooding. Squall line thunderstorms move in a linear front that can exceed 100 miles in length, with the strongest rains and winds at the front of the storm. Supercell thunderstorms are the largest, longest lasting, and most devastating thunderstorms. Nearly all tornadoes are formed from supercell thunderstorms. Supercell thunderstorms can also form hailstones larger than golf balls. These Supercell storms have a clockwise rotating winds that exacerbate the storm. Lightning, hail, flash flooding, and tornadoes are all associated with this type of thunderstorm." Thunderstorm activity in Warren causes power outages, damaging winds, occasional hail, intense rains, flooding and transportation and economic disruptions, particularly from blown down trees. Thunderstorms can generate high winds and down hundreds of large trees within a few minutes. According to the Vermont State Hazard Mitigation Plan, thunderstorms are the most prevalent hazard event occurring in Vermont and "severe summer thunderstorm winds occur more frequently than any other natural hazard incident within Vermont." Intense rains with severe thunderstorms cause flood and erosion hazards in Warren.

High Winds are usually associated with severe thunderstorms in Vermont. When winds are sustained at 31 to 39 mph for at least an hour or any gusts at 46 to 57 mph, the National Weather

Service will issue a wind advisory. If winds reach 58 mph or more, the National Weather Service will issue a High Wind Warning. The National Weather Service has classifications for hurricane and tropical storm winds, which can be found in the Saffir-Simpson Scale graphic found later on in this Plan as well as the Beaufort Wind Chart used to estimate wind speeds. The high winds produced by severe thunderstorms can damage crops, trees, structures, and property. High winds tend to be localized but can cause significant damage and loss, especially to farmers and woodlot owners who can lose their whole crop in a single event. High winds during thunderstorms have been common in Washington County causing numerous downed trees and power outages. This is especially a concern for the electrical and telecommunication utilities in Washington County and throughout the state due to loss in customer service and damage to infrastructure.

Hail is defined in the Vermont State Hazard Mitigation Plan as, "a form of precipitation composed of spherical lumps of ice. Known as hailstones, these ice balls typically range from 5-50 mm in diameter on average, with much larger hailstones forming in severe thunderstorms. The size of a hailstone is a direct function of the severity and size of the thunderstorm that produces it." Hail is known to cause devastating crop damage, property damage, and bodily injury if one is struck. NOAA has created a diagram to help visualize the size of hail in relation to common items like a softball or golf ball or coins as depicted further on in this Plan. Although hail is associated with severe thunderstorms it is not a significant concern of Warren and will not be discussed any further in this Plan.

Hurricanes and tropical storms are violent rain storms with strong winds that have large amounts of rainfall and can reach speeds up to 200 mph. Hurricane season is between the months of June and November. These types of storms originate in the warm waters of the Caribbean and move up the Eastern seaboard where they lose speed in the cooler waters of the North Atlantic. These storms were discussed in the 2012 Plan and are not an identified priority under this Plan. The last Tropical storm to impact Warren was in August of 2011 (Tropical Storm Irene) and prior to that in 1999 (Tropical Strom Floyd).

Warren experiences severe thunderstorms, thunderstorm winds, and high winds on a more regular basis with impacts to public and private assets and these have been identified as a more significant hazard under this Plan. Severe thunderstorm is a thunderstorm that contains any one or more of the following three weather conditions: hail that is 3/4 of an inch or greater in diameter, winds 58 miles per hour or greater, and/or tornadoes. Severe storm events can occur late spring and early summer as temperatures increase in the summer season. The frequency and intensity of severe storms is expected to increase with climate change. Overall, as one of Vermont's more prevalent hazards, Warren will continue to be vulnerable to these storms.

In 2017, severe thunderstorms, strong winds, and flash flooding of June 29 through July 1 came through Warren. Warren received 5" of rain. The Airport Road suffered twenty thousand dollars ($20,000) in damages. Four culverts had to be replaced and improved from Highland Drive up to Cockleburr Road and repairs made to address the road washouts. Warren sustained substantial damage from severe thunderstorms and thunderstorm winds during the June and July storms in

2013. The winds associated with these storms downed numerous trees and caused widespread power outages. Heavy rains from these storms washed out roads and road culverts. At the peak of the June storm, 20,000 customers in Washington County were without power. The May 26-27, 2011 severe storm with hail and thunderstorm winds was a federal declared disaster (DR 4001-VT). Warren reported 50-knot winds and 1-inch hail with numerous downed trees and power outages. The impacts from the severe thunderstorms, thunderstorm winds, high winds and associated heavy rains that result in power outages, downed trees and limbs, downed power lines, debris, and flooding will continue to create a challenge for Warren.

Warren has lessened the impacts and the town's vulnerability to the hazard of these storms with regular roadside tree trimming, mitigation actions and improvements done to its infrastructure to address flooding, and implementation of storm water management projects.

Similar to other hazard situations, to lessen the impact of these storms on the Town of Warren and its residents it is important that the community observe severe storms watches and warnings and high wind advisories and warnings and take adequate preparations. Residents are encouraged to sign up with VTAlert. In cases of high winds and thunderstorm winds, providing for the mass care and sheltering of residents left without power for extended periods of time and mobilizing sufficient resources to clear broken tree limbs from roads, are the primary challenges facing community officials. The town has applied for HMGP funding to purchase and install a generator at the Town Hall, to upgrade and enhance its capacity as a town emergency shelter. Previously the town received funding for the purchase and installation of generators at the two fire stations, which also serve as shelters for the community when needed. The town will need to seek grant funding to support the Town Hall generator project. The Town encourages residents who are in remote locations to be equipped with generators and backup fuel, water, food, and medical supplies in the event of prolonged power outages and travel restrictions. In the event of an extended power outage, the Town is in the position to open its emergency shelters. Often, residents without power will seek family and friends to stay with during the duration of an outage.

The Town equipment is maintained on a regular schedule and the Selectboard with the input from the Road Foreman, budget for equipment replacement. Other town critical facilities such as the Emergency Operations Center housed at the Town Offices, the Police Department and the Fire Stations have been newly renovated and upgraded for energy efficiency and municipal water. The electrical upgrades will help prevent surge and equipment damage from fluctuating current during ice and wind storms.

Green Mountain Power follows a regular tree-trimming schedule and line-clearing program that has reduced the number and severity of power outages in the community. The lack of power and telecommunications throughout the town is especially concerning for the most vulnerable populations; the elderly, disabled and medically dependent. Lack of access to power and telecommunication services can hinder response efforts.

In the event of thunderstorms producing heavy intense precipitation which can cause localized flooding, Warren has lessened the impacts and the town's vulnerability to the hazard of flooding/flash flooding/fluvial erosion with mitigation activities and improvements as noted under the Flood/Flash Flood/Fluvial Erosion section of this Plan.

Beaufort Wind Chart – Estimating Winds Speeds

Beaufort Number	MPH Range	MPH Average	Terminology	Description
0	0	0	Calm	Calm. Smoke rises vertically.
1	1-3	2	Light air	Wind motion visible in smoke.
2	4-7	6	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	11	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	15	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	22	Fresh breeze	Smaller trees sway.
6	25-31	27	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	35	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	42	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	50	**Severe gale**	**Light structure damage.**
10	55-63	60	**Storm**	**Trees uprooted. Considerable structural damage.**
11	64-73	70	**Violent storm**	**Widespread structural damage.**
12	74-95	90	**Hurricane**	**Considerable and widespread damage to structures.**

Webpage: http://www.weather.gov/iwx
Twitter: @nwsiwx
Facebook: NWSNorthernIndiana

https://www.spc.noaa.gov/misc/tables/kt2mph.htm

CONVERTING KNOTS to MPH

For assessment and translation of severe wind reports.

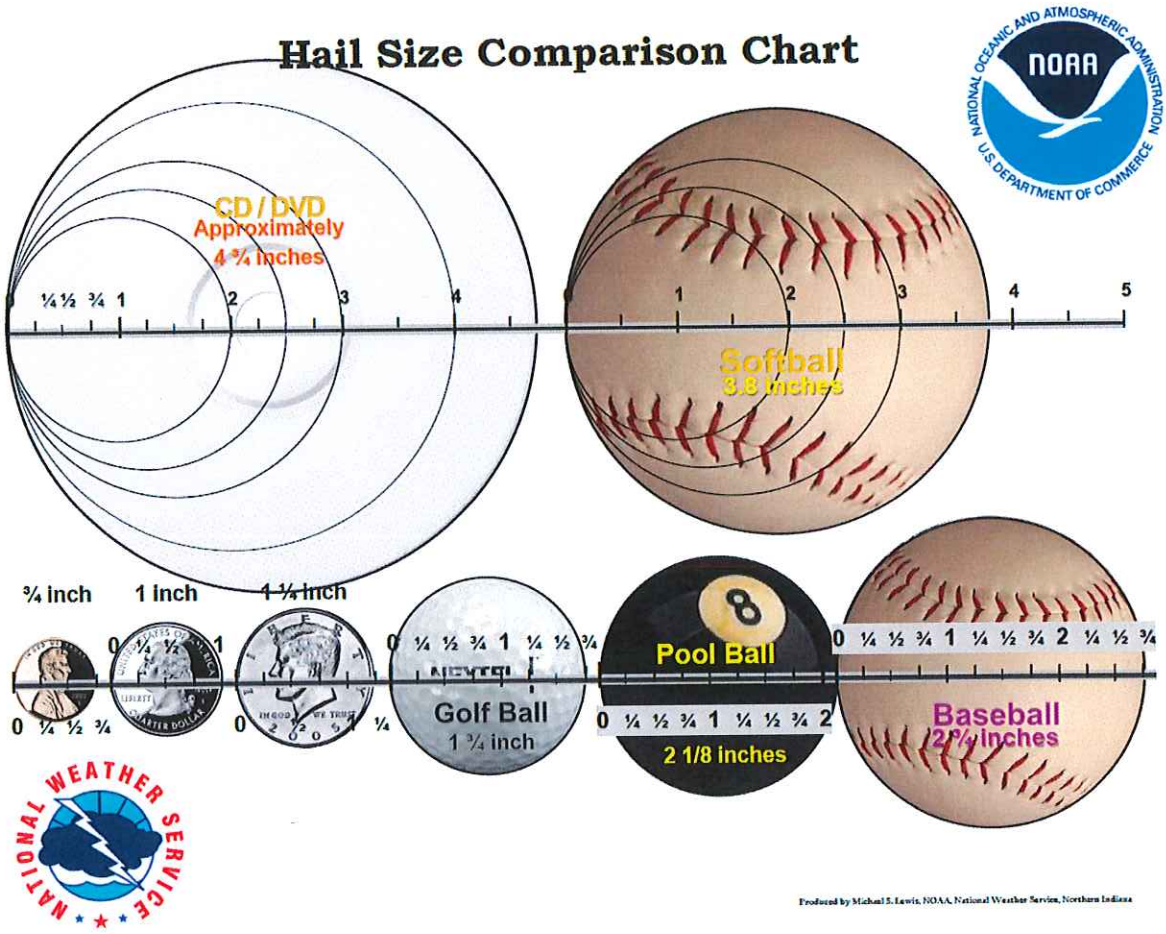
KNOTS	MPH	KNOTS	MPH	KNOTS	MPH
50	58	71	82	92	106
51	59	72	83	93	107
52	60	73	84	94	108
53	61	74	85	95	109
54	62	75	86	96	111
55	63	76	88	97	112
56	64	77	89	98	113
57	66	78	90	99	114
58	67	79	91	100	115
59	68	80	92	105	121
60	69	81	93	110	127
61	70	82	94	115	132
62	71	83	96	120	138
63	73	84	97	125	144
64	74	85	98	130	150
65	75	86	99	135	155
66	76	87	100	140	161
67	77	88	101	145	67
68	78	89	102	150	173
69	79	90	104	155	178
70	81	91	105	160	184

SPC Home Page, SPC Forecast Products

Saffir-Simpson Scale for Hurricane Classification				
Strength	**Wind Speed (Kts)**	**Wind Speed (MPH)**	**Pressure (Millibars)**	**Pressure**
Category 1	64- 82 kts	74- 95 mph	>980 mb	28.94 "Hg
Category 2	83- 95 kts	96-110 mph	965-979 mb	28.50-28.91 "Hg
Category 3	96-113 kts	111-130 mph	945-964 mb	27.91-28.47 "Hg
Category 4	114-135 kts	131-155 mph	920-944 mb	27.17-27.88 "Hg
Category 5	>135 kts	>155 mph	919 mb	27.16 "Hg
Tropical Cyclone Classification				
Tropical Depression	20-34kts			
Tropical Storm	35-63kts			
Hurricane	64+kts or 74+mph			

Guide for determining hail sizes:

less than 0.50" Pea
0.50" - Marble/Mothball
0.75" - Dime/Penny
0.88" - Nickel
1.00" - Quarter
1.25" - Half Dollar
1.50" - Walnut/Ping Pong
1.75" - Golf Ball
2.00" - Hen Egg
2.50" - Tennis Ball
2.75" - Baseball
3.00" - Tea Cup
4.00" - Grapefruit
4.50" - Softball



Severe Thunderstorms/Thunderstorm Winds/High Winds

Hazard Overview Matrix:

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Severe Thunderstorms, Thunderstorm Winds, High Winds.	Town wide, all roads, public infrastructure, utility poles and lines, Town Forest, National Forest, private woodlots/ timber stands, residences and businesses, farms, water supply systems and water treatment systems. Especially the Airport Road, Hank Road, Sugarwoods Road, Flat Iron Rd, Cider Hill Rd, Plunkton Rd, Bridge Rd, Brook Rd, & Fuller Hill Rd.	Public infrastructure & utilities, tele-communications, GMP, Town road infrastructure: culverts, low lying roads, bridges, private property, power lines, trees, school system. Structures in SFHA & FEH areas. Farmers and loggers who earn livelihood from forest products and crops. Elderly, handicapped, and medically dependent populations, remote structures.	8/28/2011- T.S. Irene – sustained winds 50 mph; 5.75" of rain in 24 hours, Mad River flood gauge at 19.07 feet; 9 feet is flood stage. 6/29/2017- 7/1/2017: 3-4 inches heavy rainfall, localized thunderstorm with high strong winds toppling trees. 7/19/2015- 7/20/2015: 50 knot winds, up to 1" hail; torrential rainfall. 7/18/2013 - 50 knot winds	$591,478 federal share of obligation from Irene for 15 projects. $20,000 damages to Airport Road washout and trees & power lines down in roadway. Power outages townwide, trees and large branches down on Airport Road Downed trees on several roads in and around Warren.	Highly Likely

Severe winter weather –Ice storms and Snow storms = > 18 inches of snow/storm event

History of Occurrences: The following chart indicates the history of occurrence with regard to severe winter weather in Warren specific to ice storms and excessive snow fall; defined as equal to or greater than 18 inches. Data is local, county-wide and state-wide. Specific data for Warren is limited or difficult to obtain but when available it is provided in the History of Occurrences chart. Federal declared disaster numbers are noted where applicable.

Information to complete the history of occurrences was taken from the National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information (NCEI), formally the National Climate Data Center (NCDC), the FEMA Declared Disasters in Vermont data base, the State of Vermont Hazard Mitigation Plan dated November 2013, and town records.

Severe winter weather

History of Occurrences: Snow and/or ice events occur on a regular basis. Recent significant events have included:

Date and Disaster Declaration Number if applicable	Event (By FEMA classification)	Location	Extent(measurement) and Impact, if known, ($ damages, # persons, other narrative)
04/7/2018	Winter Ice Storm	County Wide	4-5" of freezing rain, sleet, snow mix 1200 Warren customers without power.
3/13/2018-3/15/2018	Winter Storm	County wide, Warren,	23 inches snow in Warren; scattered power outages.
3/14/2017-3/15/2017	Winter Storm	State wide; County wide, Town of Warren	23 inches snow in Warren. Snowfall rates at least 1 to 3 inches per hour for several hours; numerous sites witnessed 4 to 5 inches per hour snowfall rates for more than one hour. Blizzard to near blizzard conditions developed around the time of the heaviest snowfall lasting for 3-4 hours within several miles of Lake Champlain and higher exposed terrain as well. Total snowfall across Vermont was 12 to 36+ inches. Numerous schools, businesses and local government offices closed for 14th and 15th with numerous vehicle accidents and stranded vehicles. Washington County 25K property damage NOAA.

12/9/2014-12/11/2014	Winter storm	State wide; County wide, Town of Warren	Heavy, wet snowfall totals across Washington county ranged from 6 to 24 inches with 23 inches in Warren. The heavy, wet nature of the snow resulted in widespread power outages with 175,000 plus power outages in the region from December 9th through December 12th. This was the 2nd most power outages due to weather in the state of Vermont. Also widespread vehicular accidents. Washington County 250K damages per NOAA.
3/12/2014-3/13/2014	Winter storm	State wide; County wide, Town of Warren	20 inches snowfall in Warren. In addition to heavy snowfall accumulations, strong northeast-north winds with gusts to 35-40 mph at times caused considerable blowing and drifting of the snow. Numerous motor vehicle accidents, school and business closures resulted due to the storm on both March 12th and 13th. Washington County 40K damages per NOAA.
12/20/2013 DR 4163-VT	Ice storm	Northern VT counties	Warren was not part of declaration but according to locals had icing and power outages; specific town data not available. Freezing rain accumulated between 3/4 to one inch, across portions of Lamoille county.
12/26/2012-12/28/2012	Winter storm	State wide; County wide, Town of Warren	20 inches of snow in Warren; heavy snowfall at times with a rate of 1-2 inches per hour. Yielded numerous vehicle accidents. This was the first widespread snowfall of more than 6 inches since March 2011. Damages in Washington County 20K per NOAA.
11/23/2011	Winter storm, wet heavy snow, ice storm, sleet mix	Statewide; Warren	11 inches heavy snow accumulation in Warren; a heavy, wet snow mixed with rain, freezing rain and sleet at times fell across Washington County. Numerous vehicle accidents, isolated to scattered power outages due to wet, heavy snow bending or breaking tree limbs onto power lines.

3/6/2011	Winter storm, heavy snow and ice accumulation	State wide; County wide	Snowfall amounts of 15 to 30 inches were reported in Washington county, including, 26 inches in Waitsfield and Waterbury and ice accumulation up to 1/4 inch in Central Vermont. Dropping temps caused heavy rain change to heavy sleet, and then wet snow. Icing created a main hazard. 10,000 customers lost power statewide. At the same time, rapid snow melt and heavy rainfall accounted for ice-covered rivers to swell and cause ice flows. Ice jams and flooding related problems in the Passumpsic, Missisquoi and Winooski river valleys. Most roads were impassable with numerous accidents and stuck vehicles with portions of Interstate 89 closed multiple times. Burlington Int'l Airport closed. Schools & government offices closed. Slightly more than a dozen dairy farms lost milk production due to trucks unable to reach farms and production facilities.
2/5/2011-2/6/2011	Winter storm, ice storm, thundersnow	Statewide	Snowfall rates up to 3 inches per hour. A heavy wet snowfall (8:1 snow/water ratios) of 6 to 12 inches occurred across the northern third of Vermont, 4 to 8 inches of snow and sleet with some freezing rain across the central third of Vermont and primarily sleet and freezing rain with a few inches of snow across southern Vermont. In addition, thunderstorms that contained snow, sleet or freezing rain moved across the entire state. Snow depths (and Snow water equivalents) after this storm were generally 18 to 30 inches (4 to 6 inches in the valleys with 36 inches or greater (6+ inches) across the higher terrain. This resulted in heavy snow loads and nearly a dozen structure failures of garages, barns and carports with a few barn collapses resulting in injured or killed livestock.

2/2/2011	Winter storm,	State wide; County wide	Snowfall totals across Washington county were 10 to 20 inches. Snowfall rates in excess of 2 inches per hour at times.
2/23/2010	Winter Storm	State wide; County wide; Warren	32 inches of heavy wet snow in Warren. 50,000 customers lost power statewide.
2/22/2009	Winter Storm	County Wide, Warren	16" of snow and 30 mph wind gusts in Warren.
12/19/2008-12/21/2008	Winter storms	Statewide	This was the second significant snowfall within 36 hours which led to additional vehicle accidents and exhausted snow removal resources. **Snowfall totals in excess of 24 inches within 36 hours** led to blocked ventilation pipes and some carbon monoxide injuries as well as a few collapsed small farm structures due to the weight of the snow.
2/1/2008	Winter storm; combined snow, sleet, freezing rain	County wide, Warren	3-7 inches of snow, ¼-1/2" thick ice accumulation, 50 mph wind gusts. Mix storm of snow, freezing rain, and sleet. This wintry mix accounted for hazardous road conditions, numerous vehicle accidents and multiple school, civic and government closings on February 1st. In addition, very strong winds caused power outages.
2/14/2007	Winter storm	County wide, Warren	22" of snow. Snowfall rates of 2 to 4 inches per hour. Brisk winds of 15 to 25 mph; whiteout conditions; blowing and drifting snow, making roads nearly impassable; wind chill values of 10 degrees below zero or colder. The deep snowfall (18-30 inches) and deeper snow drifts (4-6+ feet) caused numerous problems: blocked heat vents, build-up of carbon monoxide in homes, people seeking treatment at area hospitals, vehicle accidents and cardiac arrests due to overexertion during snow removal, partial or total collapse of 20+barn roofs and the deaths of more than 100 cattle. Snow removal operations took several days/week.

2/14/2006	Winter storm	Warren, County Wide	30" of snow
1/4/2003	Winter storm	County wide	19" of snow
3/5/2001	Winter storm	County wide, Warren	15-30" of snow
12/31/2000	Winter storm	County wide	10" of snow
1/5/1998-1/9/1998	Ice storm	Statewide; Washington County	½ inch ice thickness mostly between 1500 and 2500 foot level. The ice accumulations resulted in damage to many trees, with power lines snapped due to the weight of the ice resulting in many brief power outages. Numerous vehicular accidents reported.
1/15/1998	Winter storm	County wide, Warren	10-12" snow (not a DR in Washington County)
12/29/1997	Winter storm	County wide, Warren	21" of snow
12/7/1996	Winter Storm	County wide	12" of snow
3/21/1994	Winter storm	County Wide, Warren	5-11" of snow
11/1/1993	Winter storm	County wide, Warren	15" of snow
1/3/1993	Freezing Rain	Statewide	

A winter storm is defined as a storm that generates sufficient quantities of snow, ice or sleet to result in hazardous conditions and/or property damage. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is similar to hail only smaller and can be easily identified as frozen rain drops (ice pellets) that bounce when hitting the ground or other objects. Sleet does not stick to wires or trees, but in sufficient depth, can cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surfaces coating the ground, tress, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. Periods of extreme cold tend to occur with these events. There is no set definition of extreme cold; however, a period of extreme cold is often characterized by temperatures at or below freezing for an extended period of time.

One of the major problems associated with ice storms is the loss of electrical power. Major electric utility companies have active, ongoing programs to improve system reliability and protect facilities from damage by ice, severe winds and other hazards. Typically, these programs focus on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting equipment from lightning strikes and placing new distribution lines underground. Other major problems include closed roads and restricted transportation.

NOAA defines Heavy Snow as generally snowfall accumulating to 4" or more in depth in 12 hours or less; or snowfall accumulating to 6" or more in depth in 24 hours or less. In forecasts, snowfall amounts are expressed as a range of values, e.g., "8 to 12 inches." However, in heavy snow situations where there is considerable uncertainty concerning the range of values, more appropriate phrases are used, such as "...up to 12 inches..." or alternatively "...8 inches or more..." A Blizzard is defined as conditions that are expected to prevail for a period of 3 hours or longer that involve sustained wind or frequent

gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than a ¼ mile).

Vermont is known for its cold snowy winters and Vermont towns and their residents are generally equipped to handle this weather. It is when the winter weather becomes extreme that a hazard is created. Severe winter storms bring heavy snow loads, ice, damaging winds, dangerous wind chills, below zero temperatures, power outages, downed trees and power lines, collapsed roofs and buildings, stranded motorists and vehicles, road closings, restricted transportation, and school and business closings. The physical impacts of winter storms are town wide due to the expansive nature of winter storms. In Warren, it is the heavy snows and ice that is of most concern.

Heavy snowfall – Warren is significantly affected when it experiences an accumulation of 18 inches or more of snow in a 24-hour period.
Blizzard – Warren is significantly affected when they experience sustained wind speeds in excess of 40 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow.
Ice storm – Warren is significantly affected when they experience ice accumulations of ¼" or greater.

Although winter storms are a frequent occurrence, the extent of winter storms within Warren is difficult to estimate as it is dependent on the size and path of the storm. In general, Warren does not consider a storm of less than 18 inches of snowfall significant because they are generally equipped to handle it. Based on past occurrences, the worst anticipated winter weather Warren could experience would be a storm resulting in one and a half feet or more of snow in a 24 hour period, with more at higher elevations and several days of power outages. Complicating the storm would be a mixture of freezing rain with ice formation and accumulation.

In Warren's recent history, intense snow/ice events tend to occur more frequently during the month of March. The March storms of 2018, 2017, 2014, and 2011 saw heavy snows (greater than 18 inches at a time) resulting in power outages, downed trees and power lines, closings of schools, businesses, and governmental offices, and vehicular travel difficulty and accidents. It is not unusual for Warren to also experience snow storms with mixed precipitation of freezing rain and or sleet which has become more common in the past five years. The statewide December 2014 winter storm that extended from the 9th to the 13th was a federally declared disaster, DR4207-VT, resulting in heavy wet snow, 23 inches falling in Warren. This snow had a snow to water ratio of 8:1 causing over 175,000 power outages in the region, the second most power outages due to weather in the state of Vermont at that time. FEMAs total Public assistance grant funds obligated to the state was $3,949,028.57. The storm also resulted in widespread vehicular accidents. According to the NOAA severe weather data site, Washington County sustained 250K in damages. Overall, in the past five years the severe winter weather has spared the state of Vermont compared to the historical records of the past when heavy snowstorms and winter storms were more frequent and common. Power outages caused by broken tree limbs or downed trees and power lines from wet heavy snow loads or ice storms continue to create a challenge to the town and the state.

By observing winter storm watches and warnings, adequate preparations can usually be made to lessen the impact of snow, ice and sleet conditions on the Town of Warren. The Town and State are well

equipped and experienced to deal with winter conditions and snow/ice removal. Providing for the mass care and sheltering of residents left without heat or electricity for an extended time and mobilizing sufficient resources to clear broken tree limbs from roads, are the primary challenges facing community officials. Warren should plan and prepare for these emergencies. That planning and preparedness effort should include the identification of mass care facilities and necessary resources such as cots, blankets, food supplies and generators, as well as debris removal equipment and services.

The Town shelter locations are the Warren Town Hall, Warren Fire Department, and Sugarbush Ski Resort. The town buildings were recently renovated with a new municipal water system and energy efficiency measures. Upgrade electrical systems in municipal buildings and shelters to prevent surge/equipment damage from fluctuating current during ice and wind storms has been completed. In 2018, Warren applied for a HMGP infrastructure project to fund the purchase and installation of a generator for the Town Hall enhancing its capacity as a shelter and ensuring an uninterrupted water supply to the "municipal complex" within the village. The town is awaiting a decision on the application submittal from the state. This generator project requires outside funding to go forward.

The Town encourages residents who are in remote locations to be equipped with generators and backup fuel, water, food, and medical supplies in the event of prolonged power outages and travel restrictions. In the event of an extended power outage, the Town is in the position to open one or more of its emergency shelters. Often, residents without power will seek family and friends to stay with during the duration of an outage.

The lack of power and telecommunications throughout the town is especially concerning for the most vulnerable populations; the elderly, disabled and medically dependent. Lack of access to power and telecommunication services can hinder response efforts. Green Mountain Power follows a regular tree-trimming schedule and line-clearing program that has reduced the number and severity of power outages in the community. GMP has online real time outage tracking tools. The Warren Public Safety Department is working with the United Way and Vermont E-911 to encourage individuals with special needs to register with the E911 database by completing an E-911 Disability Designation Form and or a CARE (Citizen Assistance Registration for Emergency) form. The fire department volunteers and town constables often will do wellness checks during an emergency event.

Over the last five years the town purchased and installed a generator for the Town Garage using HMGP funds. Additional communication devices were purchased for the Department of Public Works to improve communications in the town highway vehicles/trucks. Town equipment (trucks, plows, etc.) is maintained on a regular schedule and the Selectboard with the input from the Road Foreman, budget for equipment replacement based on the towns equipment replacement schedule. The Town maintains a five man crew to handle the work load and is able to keep up with the storms and winter.

Many of the impacts from these hazards can be reduced by using common sense and practicing preparedness measures such as staying off the snow and ice covered roads until they are cleared, having vehicles equipped with proper winter gear and snow tires, using moderation and resting when removing snow and cleaning up from a storm, keeping heating pipes cleared and well ventilated, keeping roofs clean of heavy snow/ice loads, checking on and helping the elderly and disabled residents

of the community, and listening to the local weather forecast for storm updates. Participating in the free VTAlert system is highly encouraged and an important resource in emergency preparedness. The Town's website and the Mad River Valley TV are outlets used to help educate and remind residents how to be prepared for winter weather and be aware of its hazards.

Extent Scale - Winter Weather Alerts

Winter Weather advisory	This alert may be issued for a variety of severe conditions. Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events.
Winter storm watch	Severe winter weather conditions may affect your area (freezing rain, sleet or Heavy snow may occur separately or in combination).
Winter Storm Warning	Severe winter weather conditions are imminent.
Freezing rain or freezing drizzle	Rain or drizzle is likely to freeze upon impact, resulting in a coating of ice Glaze on roads and all other exposed objects.
Sleet	Small particles of ice usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous.
Blizzard Warning	Sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. This alert is the most perilous winter storm with visibility dangerously restricted.
Frost/freeze warning	Below freezing temperatures are expected and may cause significant damage to plants, crops and fruit trees.
Wind Chill	A strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor.

The following matrix provides an overview of the severe winter weather pertaining to ice and snow.

Severe winter weather – ice storm/snow storms = or > than 18 inches

History Overview Matrix:

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Winter Storm/Ice Storm	Town Wide. All roads, utility poles and lines, Town Forest, private woodlots/timber stands, residences, businesses, public infrastructure, schools.	Elderly & handicapped populations, remote structures, old/under insulated structures, utilities, trees, telecommunications, School system, road system.	3/13/2018-3/15/2018: 23" snow. 3/14/2017 – 3/15/2017: 23" snow. 12/9/2014 – 12/11/2014: 23" wet snow 3/12/2014 – 3/13/2014: 20" snow, 35-40 MPH winds, 3/6/2011 15"-30" snow-1/4" ice accumulation 2/14/2007 22" snow, 15-25 mph winds	Scattered power outages 25K Washington County damages; schools, local gov. businesses and offices closed; vehicle accidents and stranded vehicles, power outages 175,000 customers without power region wide; 250K Washington county damage costs; schools, businesses, government closed, trees down, vehicular accidents, roads closed. Vehicular accidents, school and business closures, Washington County 40K damages 10,000 lost power statewide, roads closed, schools businesses closed. Power outages, vehicular accidents, roads closed, costly snow removal, carbon monoxide poisoning, structure collapses.	Highly Likely

5.3 Moderate Threat hazards

Structure Fire

A **structure fire** is a fire involving the structural components of various types of residential, commercial or industrial buildings. Residential buildings range from single-family detached homes and townhouses to apartments and tower blocks, or various commercial buildings ranging from offices to shopping malls.

Structure fires are common in Vermont and a leading cause of deaths in the state. Despite mechanisms to prevent and alert occupants to a fire hazard, many structures are without working fire alarm systems or carbon monoxide detectors. Some, simply because the batteries have not been changed. The 2014 Braintree Hazard Mitigation Plan describes a structure fire in simple terms and it is included here. "Structure fires may occur at any point, and are typically initiated within a single fuel object. Smoke produced by the burning object forms a smoke plume and rises, creating a layer of smoke while also transporting heat to the smoke layer. Fire then spreads quickly by radiation from the flames, or from the smoke layer. Once other objects are engulfed, more smoke plumes are formed and heat radiates to other objects. Fire burns and moves across different materials depending on the material's composition, orientation, surface to mass ratio and air supply in the structure/room." Warren is most likely to have a residential structure fire since it is a resort community with a majority of housing structures present.

The Warren Volunteer Fire Department is responsible for local fire protection. It manages a station in Warren Village and at Lincoln Peak base area (part of Sugarbush Resort). Warren is a member of mutual aid systems Washington counties, working alongside Waitsfield, Moretown and Fayston Fire Departments. The Town owns 23 dry hydrants. The town has explored the potential for future dry hydrant locations but developing new locations will be dependent upon site accessibility and securing grant funding. Currently there are no plans to develop additional dry hydrants.

The nature of the majority of calls has not changed and remains as fire related incidents – about one sixth of the calls received in 2017 by Warren's fire department were chimney fires, dumpster fires, smoke alarms, and carbon monoxide alarms. Although many structures in Warren are less than 100 years old, many residents heat their homes with wood or pellet burning stoves. According to the Town Plan, many of the seasonal/second homes built during the 70's and 90's are in need of repair and improvements, especially for fire safety. The remoteness and distance from fire and emergency services of many homes also increases the likelihood of a home being completely, opposed to partially, destroyed by a fire. Large, vacant condo complexes, which are not regularly checked upon also pose threats.

The fire department responded to 80 calls during 2017, an increase over previous years. (*Annual Report of the Town and Town School District for the Year Ending December 31, 2017, Town of Warren, Vermont*). On February 17 2014, a devastating fire destroyed 36 units at a Mountainside Condominium building. The fire was traced to "the building's fireplace inserts, which are known to heat up over time." (Valley Reporter, 4/23/15, Rachel Goff, *Condo Owners Notified of No Burn Ordinance*). In December 2015, a

fire at the Summit condos in Sugarbush Village damaged two rental units. "After December, Summit Condominium Association was put under a no-burn order from the state, but in order to avoid future fires, the select board agreed to look into establishing a no-burn order for all resort lodging. (Valley Reporter, Rachel Goff 4/23/15). These fires and a significant number of false fire alarms and CO2 alarms caused by mechanical failure or human error prompted the Fire Department to take regulatory action.

In 2015, the Fire Department and town officials drafted two separate ordinances to protect public safety and reduce the number of incidents requiring personnel and equipment to respond to non-emergency situations i.e. false alarms. The goal is to help reduce town expenditures and increase availability to respond to needed protection of life and properties. On September 22, 2015 the Warren Alarm Ordinance was passed and adopted by the Selectboard. Condominium owners and Property Managers are required to register and maintain the alarms in the buildings with fees and penalties assed for non-compliance. In an effort to address wood burning appliances in multi-unit dwellings, the Selectboard passed and adopted the town of Warren Solid Fuel Burning Appliance Ordinance on May 24, 2016 and effective June 24, 2016. The ordinance limits the use of fireplaces, wood, coal and pellet-burning stoves and any other free-standing appliance that uses fuel other than natural gas or electricity in individual units of multi-unit buildings. The goal is to increase fire safety and reduce large condo structure fires.

Information taken from Warren Town Annual Reports for 2014-2017 and MRVPD 2017 Annual Report Data. *NR=not reported

CALLS	2013	2014	2015	2016	2017
Structure Fires	13	5	1	3	1
Chimney Fires	4	5	NR		3
Smoke Alarms /Alarm Indications	6	26	17	26	26
Dumpsters / Trash Fire	3	1	1		2
Brush Fire			2	1	3
Car/Vehicle Accidents	10	8	12	7	11
Car Fires	5	1	1	3	NR
Carbon Monoxide calls	12	3	5	6	15
Propane leaks	5	1	2	1	2
Power Lines	4	8	1	5	4
Mutual Aid		5	2	1	2
Odor Complaints		6	NR		
Miscellaneous calls	12	6	6		
Community			NR	3	5
Calls cancelled en-route/False alarms	9		NR	14	4
Water Leaks			NR	1	2
Bomb Threat				1	1
TOTAL CALLS	83	75	50	72	80

Fire Overview

Structure Hazard Matrix

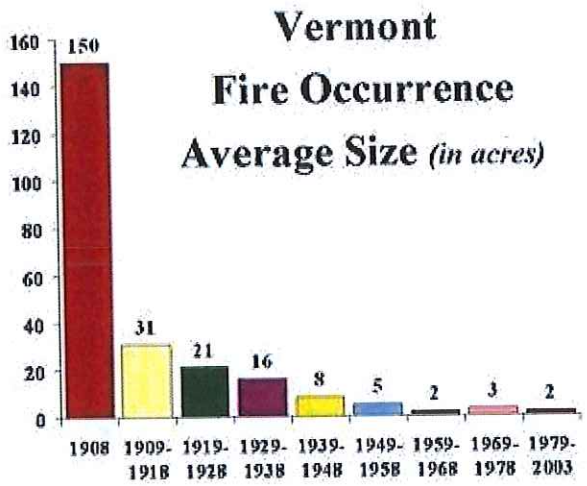
Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Structure Fires	Town Wide, increased risk in Alpine resort, Sugarbush Resort, condos,	Wood structures, especially older than 100 yrs, homes that use wood burning stoves for heat,	2/17/2014 36 units destroyed at Mountainside Condominium building;	$_____ per Unit based on median grand list value	Highly Likely

	private residences	vacant condo/ vacation homes	12/2015 two rental units destroyed at Summit Condos at Sugarbush Village		

Wild Fire/Forest Fire

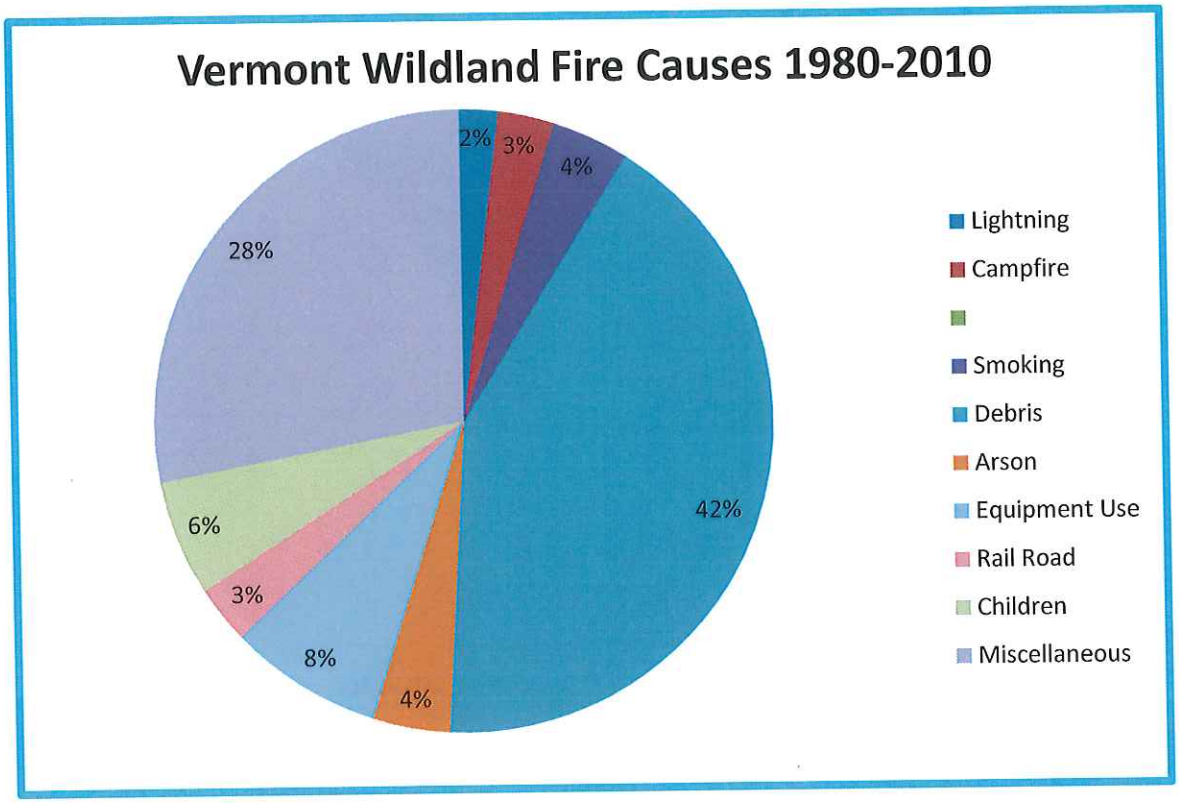
The definition of a **wildfire** is the uncontrolled burning of woodlands, brush, or grasslands. FEMA indicates there are three classes of wild land fires – surface fires, ground fires and crown fires, with the most common type indicated as a surface fire. Surface fires burn slowly along the forest floor, killing and damaging trees. Ground fires burn on or below the forest floor and are usually caused by lightning. Crown fires move quickly by jumping along the tops of trees. Crown fires can spread quickly during windy conditions. In Warren, there have been no known occurrences of wildfires; however, changing land use patterns and weather conditions may increase Warren's vulnerability. The rural nature and vast tracts of forested land can make Warren susceptible to forest fires. During rare drought occurrences, and the more frequent severe thunderstorms fire danger may be high.

In Vermont, wildfires are not a common occurrence. The Vermont State Hazard Mitigation Plan states there has not been a major wildfire in Vermont in the last 50 years. According to the Northeast Wildfire Organization, Vermont averages 200 - 400 fires a year with an average size of 1.5 to 2 acres. Back in 1908, the average fire size was 150 acres. The area of acres burned in Vermont has consistently gone down each year. The table to the right shows this decline and was taken from the Northeast Wildfire Organization website, http://www.northeastwildfire.org/vermont.



According to the Vermont Forest Parks and Recreation, burning debris is the most common cause of wildfires in Vermont. In Vermont, wildfires are most prevalent in the spring and late summer and early fall when conditions are most favorable. Drought conditions also increase the threat of wildfires. In 1903, Vermont experienced a devastating fire season, which prompted the state to pass legislation creating a town forest fire warden program. The forest fire warden program focuses on fire prevention, suppression, and fire safety at the local level. In 1939, an amendment to the law required the use of burning permits, issued by the local fire warden. In Vermont, forest fire wardens issue 20,000 burning

permits annually. In 1966, 1999, 2000, and 2005 the state issued statewide bans on open burning due to the extreme vulnerability to the wildfire/forest fire hazard. In March of 2012, the threat of fire was severe due to the low humidity, warm temperatures, and strong winds prevalent in Vermont. The low occurrence of wildfires in Vermont is attributable to the local forest fire warden program, early detection measures, trained and equipped fire departments, and public education and outreach. The fires that do ignite tend to be small.



Warren actively participates in the Forest Fire Warden program under the VT Division of Forestry. The forest fire program focuses on prevention, fire awareness and fire fighter safety. The Commissioner of Forest, Parks, and Recreation appoints the Forest Fire Warden with the approval of the Selectboard for a five-year term, with unlimited reappointments possible. The Warren Fire Department and mutual aid provide fire suppression services when needed. The local fire warden has total authority and jurisdiction over wildland fire suppression activities in Warren. He issues burning permits, "Permits to Kindle Fire," when conditions are safe to do so, monitors the daily fire danger level, and educates Warren residents on safe burning practices. He also has the authority to ban open burning in town when fire danger is high or when conditions are hazardous. The Division of Forestry offers annual training opportunities on the latest methods, technologies and trends in wildland fire. The National Weather Service in Burlington VT posts daily fire danger levels and alerts. The fire warden program is instrumental in helping reduce and prevent the risk of forest fires in Warren, where the majority of Warren is forested with approximately 22,000 acres or 85% of its land area (Draft 2018 Town Plan). The Town website provides contact information for the forest fire warden with information on safe open burning and the permitting procedure residents must follow.

Despite the absence of recent forest fires of significant size, the volume of the Town's forested landscape in conjunction with dry and windy weather has the potential to rapidly spread fire and create a hazardous situation. Portions of Warren are unreachable by road and although the town has some dry hydrants, coverage is not extensive, limiting firefighting ability. Using grant funding from the VT Rural Fire Protection Program, in 2015 the Fleming/Cockleburr Road Pond Hydrant Repairs were completed, in 2016 the Covered Bridge Hydrant underwent repairs, and in 2006 with additional bonding, the fire department completed the construction of a 300 Gal Storage Fire Pond.

Stress caused by disease, insect infestation, and changes in climate affect the health of the forest and can lead to die off, adding more fuel availability which can increase the risk, extent, duration, and severity of a wildfire or forest fire. Land development that encroaches on forestlands presents greater threats of forest fire. In Warren, the 27,392 acres of land under conservation or open space management and natural resource protection that includes the National Forest Service, town forests, family farms, and productive forestlands helps to reduce the risk of wildfire from land development. As noted in the local Town Plan and the 2017 Vermont Forest Action Plan, a buffer between future residential development and forest land should be maintained to reduce the threat of forest fire and also protect important watershed areas. Additional impacts include loss of wildlife habitat and recreational amenities including hiking and snowmobiling trails. All impacting the local tourist economy and resident's quality of life.

Properties around the Green Mountain National Forest on the urban forest interface are at the greatest risk. Using Warren's average grand list property value, the Town in the future can calculate the impact that a major forest fire would have on homes within the Town.

The State of Vermont does have a Forest Management plan in place which addresses forest fire concerns. The 2010 State Forest Management Plan was updated in 2017. The 2017 Vermont Forest Action Plan includes several goals regarding forest fire prevention. To help prevent local forest fires, the State works with local Planning Commissions to develop Community Wildfire Protection Plans (CWPP). These plans help towns to identify and mitigate wildfire risk. A limited number of Vermont towns have a CWPP. Warren is not one of those towns. The 2017 Vermont Forest Action Plan is a good resource and tool for the Town of Warren. The table below documents average wildfire occurrences over a recent 10-year period for the State of Vermont. Warren is identified in the 2010 Vermont Forest Resources Plan as a Town at Low to Moderate Risk for wildfire (Map 32: Vermont Wildfire Risk Assessment, May 26, 2010). Data on the magnitude of forest fires affecting Warren is not available. A data gap exists.

VERMONT SPRING WILDFIRE STATISTICS		
10-year Average 2005 - 2014		
Official reports - reports have been verified by warden & VT FPR		
Month	# Fires	# Acres
March	9	29
April	62	142

May	19	30
TOTAL	90	201

Vermont Dept. Forest, Parks, & Recreation - 2015 Spring Fire Season Summary

COMMUNITY WILDFIRE PROTECTION PLANS The Healthy Forests Restoration Act (HFRA) encourages communities to develop Community Wildfire Protection Plans (CWPPs). Vermont already has a robust community-based town forest fire warden program. CWPPs can build on that foundation, although with our history of low fire danger, encouraging towns to participate in CWPPs has been challenging. However, several CWPPs have been completed in all regions of the state with input from local fire departments, planning commissions, and representatives from state and federal wildland fire agencies. These plans identify both strengths and shortcomings in effective wildland fire response in a rural landscape. With the predicted changes to our climate, wildfire risk is likely to increase. The Department will continue to encourage communities to consider CWPPs and views these plans as an excellent tool to build trust and cooperation between all partners involved in wildland fire pre-suppression efforts, identify wildland urban interface areas, values at risk from wildland fire, response time by fire departments, and access to water including dry hydrants. The Forestry Division has provided funding to third parties for the installation and maintenance of dry fire hydrants throughout the state. These hydrants provide valuable water sources in a rural state, allowing for greater access and faster resupply of water for wildland fires. Volunteer fire departments view these dry hydrants as critical assets and depend on them for pre-planning of fire incidents. The Forestry Division believes this is a worthwhile program that benefits local towns and intends to continue to fund and promote dry hydrants. (VFAP page 36-37) 25 National Weather Service, Fire Weather, 2016, www.weather.gov/btv/firewx, 2016. 37 | Page 2017 Vermont Forest Action Plan

Wildfire/Forest Fire Hazard Overview Matrix

Hazard	Location	Vulnerability	Extent	Impact	Probability
Wildfire/ Forest Fire	Green Mountain National Forest lands (30% Of Warren), Town Forest, private woodlots and timber stands; 85% of Warren land area; town wide.	Properties on urban/forest interface, private homes, road infrastructure, utilities, state, public and private forestlands, recreational trails, wildlife habitats	To date - 0 acres burned. Total forested area potential for burning is approximately 22,000 acres. No data exists for Warren.	Estimated over $30 million, plus firefighting costs	Likely

6. Mitigation

The goal of this local hazard mitigation plan is to update the local mitigation strategy that makes Warren more disaster resistant and reduces its risk from natural hazards. Further, it is the goal of this Plan to take actions to reduce or eliminate the long-term risk to human life and property from the natural and man-made hazards of:

- The natural hazard of Flood (flash flood, inundation flooding, and fluvial erosion).
- The natural hazard of severe thunderstorms, thunderstorm winds, and high winds.
- The natural hazard of severe winter weather of heavy snows equal to or greater than 18 inches and ice storms.
- The man-made hazard of structure fires.
- The natural and man-made hazard of wild fire and forest fire.

6.1 Town Plan Goals & Objectives that Support Local Hazard Mitigation

Warren's Town Plan is in the process of being updated and a draft for public comment was released in early 2018. The Town Plan is being rewritten with a consultant, Place Sense. As part of the rewrite and update, the consultant is working with the Planning Commission to identify mitigation goals that incorporate the town's hazard mitigation plan, storm water master plan and road storm water management plan, all of which are being worked on at the same time and under development. The goals and objectives of this Plan will be incorporated into future updates of the Town Plan. The next time Warren updates its Town Plan, it may consider adding additional mitigation goals. The goals and objectives of the draft 2018 Town Plan were considered when updating this Plan.

Town Plan Objectives in support of local hazard mitigation:

Resource Protection:

- ❖ To protect and enhance Warren's scenic landscape, historic built environment, rural character and cultural heritage.
- ❖ To protect and enhance Warren's natural environment, sensitive or fragile natural resources, water quality, wildlife populations, forest blocks and open space.

Land Use and Development:

- ❖ To guide development to existing settlement areas already served by public roads and other infrastructure, limit growth in rural and remote areas of town, and avoid strip commercial development along major travel corridors and in residential areas.
- ❖ To reinforce traditional settlement patterns and facilitate the logical extension of services and facilities through thoughtful planning and careful regulation of land subdivision and development.

Resiliency, Sustainability, and Adaptation:

- ❖ To ensure that the rate of growth and scale of development will not overburden community facilities or services, or undermine the community's rural character and quality of life.

- To guide development away from flood and erosion hazard areas, maintain or re-establish riparian buffers, and mitigate the impact of flooding and erosion on existing development in hazard areas.

Infrastructure and Transportation:

- To reduces transportation demands by guiding development to existing settlements and away from remote areas, and by promoting energy-efficient alternative to private automobiles such as transit, carpooling, walking and biking.
- To recognize that town roads and bridges contribute to Warren's historic, scenic, and rural character, and to manage that infrastructure in a manner that meets community needs without adversely impacting community character.
- To use the town's ability to plan and provide roads, sidewalks, sewer and other infrastructure necessary to facilitate development to foster the land use patterns called for in this plan (Town Plan).

Administration and Governance:

- To revise and readopt this plan (Town Plan) as necessary to meet state requirements and respond to changing conditions, needs and priorities in Warren.

Regional Coordination and Cooperation:

- To work in partnership with surrounding communities, regional or state organization, state government to further the goals and objectives of this plan.

Town Plan Strategies in support of local hazard mitigation, summarized:

- Maintaining Rural Character –
  - Continued contributions to the Warren Conservation Reserve Fund for purchases and easements of lands and resources identified as priorities for permanent protection.
  - Continue to work with and support the work of Friends of the Mad River to assess and correct water quality concerns or identified problems.
  - Implement and strengthen as necessary Warren's Land Use Regulations which protect natural resources and fragile features such as headwater streams, wetlands, steep slopes, ... on land being developed or subdivided.
- Fostering Appropriate Growth and Development –
  - Continue to limit development on 15% - 25% slopes and prohibit development on slopes >25%.
  - Prohibit creation of parcels for development that are not suitable due to floodplain, steep slopes, wetlands, shallow soils, bedrock high elevations, and natural heritage site features.
  - Maintain and strengthen the subdivision regulations to ensure erosion control and storm water management.

- Maintain the Special Flood Hazard and River Corridor Overlay Districts provisions and update as needed to maintain the town's eligibility for the NFIP and to enhance disaster preparedness and resiliency.
- Use the Land Use Regulations to require that storm water is managed during and after construction, maintain an undisturbed natural minimum 50 feet buffer along all mapped waterways.

❖ Improving Infrastructure, Facilities and Services –
- Support implementation of the MOU with Sugarbush Resort and follow MOU to ensure expansion development is in town and regions capacity.
- Develop an emergency power generation plan for all municipal buildings.
- Develop a long term master road management plan

❖ Promoting Effective, efficient, and Responsible Governance –
- Include potentially affected parties early on in the planning and decision making processes
- Review and update Land Use Regulations
- Continue to administer the standards in the Flood Hazard Overlay District in the Land Use and Development Regulations, and update them as needed to maintain town eligibility in the National Flood Insurance Program and as river conditions change.
- Continue ongoing contact with GMP regarding growth and future electrical capacity issues.
- Maintain the Capital Budget and Program to forecast capital needs and plan expenditures in a coordinated manner for new or improved public roads, infrastructure buildings, vehicles, equipment, lands or facilities

Some of the local hazard mitigation strategies and actions identified in this Plan over the next five years address some of the identified strategies of the 2018 Draft Town Plan. As the town further develops the strategies identified in the Town Plan, into specific actions, they may be incorporated into the next update of the local hazard mitigation plan, as applicable and appropriate.

6.2. Proposed Hazard Mitigation Programs, Projects & Activities

Hazard mitigation programs, projects and activities that were identified for implementation at the Warren Local Hazard Mitigation meeting follow. The committee looked at a comprehensive approach and included actions that addressed planning and regulatory strategies, administrative and technical strategies, financial strategies, and educational and outreach strategies.

Hazard	Action	Local Leadership	Prioritization	Possible Resources	Time Frame
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Develop a Road Stormwater Management Plan under the MRGP that includes the road erosion inventories and implementation plan and schedules of 2018.	Selectboard, Road Foreman, Town Administrator, CVRPC Transportation Planner	High	Clean Water Fund, local Town Budget	2 years Complete by fall of 2019 - 2021
All hazards	Complete work on "very high" priority road segments identified under the MRGP Road erosion inventory. Potential roads for inclusion in the work plan to include Plunkton Road, Roxbury Mountain Road, Prickly Mountain Road, Fuller Hill Road, and West Hill Road.	Selectboard, Road Foreman, Town Administrator, CVRPC Transportation Planner	High	Clean Water Fund, Better Roads grant, local Town Budget	1-7 years; all work to be completed by 12/31/2025. Under first permit implementation year of 2021 -2022, must upgrade 15% of the non-compliant segments. All work is at the discretion of the town and subject to change as needed.
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Develop Stormwater Master Plan for 5 valley towns	Friends of the Mad River, CVRPC, Selectboard, AOT, MRVPD	High	Ecosystem Restoration grant	1-2 years 2019 - 2021
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Implement and construct the Warren School campus parking lot stormwater project.	Selectboard, Friends of the Mad River, Road Foreman, Warren School	High - Medium	FMR Slow Spread and Sink initiative; Eco-Restoration grant program award	1-2 years 2019-2021

Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Complete Fuller Hill Road storm water project; implement phase II of project	Friends of the Mad River, Selectboard, Road Foreman	Medium - High	Ecosystem Restoration Grant, AOT funds	1-2 years 2019-2021
Flooding/Fluvial Erosion, Severe Thunderstorms, Thunderstorm Winds	Sugarbush Access Road 3 large Culverts – Culvert Liners	Road Foreman/Town Admin	Med	Better Back Roads funding and local highway budget (taxes)	To be completed by 12/31/2018
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Reface, replace and upgrade the Covered Bridge Abutment per 2011 engineering study recommendations	Dept. of Public Works, Selectboard, ZA, Historic Preservation, AOT	Medium - Low	HMGP, Historic Preservation and Trust, AOT grant, local funds	Dependent upon resolution with Historic Preservation and receipt of grant funding 2018-2023; may take all of five years to implement and complete.
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Implement management practices identified in the Management Plan for the three floodplain properties owned by Warren; Plan developed by the Conservation Commission & SB	Selectboard, Conservation Commission, Friends of the Mad River	Medium	High Meadows grants, Ecosystem Restoration, Friends of the Mad river, volunteers, town budget.	Ongoing over 5 year period as funding, town capacity, and priority dictate 2019-2023
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Adopt River Corridor ordinance and regulations	Planning Commission, Selectboard, CVRPC, MRVPD	Medium	ANR, HMGP, PDM, Clean Water Fund	2-3 years 2020-2022
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Support the Storm Smart program ("Slow, spread, and sink" initiative) of FMR to help landowners	FMR, RRTF, Selectboard, Conservation commission, Planning	Medium	FMR, High Meadows fund	Ongoing initiative over next five years 2019-2024

	understand, identify, and control stormwater runoff problems in order to protect the watershed and strengthen the climate resilience of the Mad River Valley.	Commission, town volunteers			
All hazards	Adopted revised and updated 2018 Town of Warren Town Plan	Selectboard, Planning Commission	High	ACCD- MPG; town budget	1 year; To be completed by 12/31/2018
All hazards	Install upgraded Hanks Brook Culvert – Conjunction with Fish and Wildlife, Friends Of The Mad River	Selectboard, Road Foreman, Town Administrator, F&WS, FMR, ANR	Medium	AOT funds, town budget	1-2 years Funds available in 2020 - 2021
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Mill Road Retaining Wall	Selectboard, Road Foreman, Town Administrator	High	HMGP $112,500	2019 - 2020
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Flat Iron Road Project	Selectboard, Road Foreman, Town Administrator	Low	HMGP, Eco-Restoration grant program, town local budget	2020-2021
All Hazards	Communications – Up date Velcro Cell Tower with Repeater Frequencies	Warren Fire Department, Selectboard, Public Input on Tower Application	Med	Private business, local budget.	1 year 2020
Structural Fires/Wild Fires	Update Forest Mutual Aid Document	Town Admin. Warren Fire Chief, Selectboard, USFS, GMNFS	Med	Town Taxes, USFS	1-2 years 2020-2021

Structural Fires/Wild Fires	Hydrant Ordinance/amending current Wood Burning/Sprinkler Ordinance	Warren Fire, PC, SB, Town Admin	Med	Town resources and budget	1-3 years 2020-2022
Wild Fire	Develop and distribute public education materials about reducing wild fire risk	Fire Department, Forest/Fire Warden, Select Board	Med	USDA, USFS, VT Rural fire Protection Task force, Town budget	Ongoing over a 5 year period 2020-2026
Wild fire	Work with State to develop alternative water supplies in Green Mountain National Forest for wildfire suppression purposes	P.C, Fire Department, Fire Warden, VT ANR FPR, Selectboard, GMNFS, VACD	Med	EMGP, USDA, USFS	5 years 2020-2026
Severe winter weather-snow & ice	Weatherization Projects/Information	Energy Committee	Low	Town Resources	2-3 years 2020-2023
All Hazards	Develop a Town newsletter with distribution via Town website as a tool for public engagement and source of educational preparedness and recovery information	SB/Town Admin	Low	Town Resources	Ongoing over next five years 2019-2024
Flood hazard, severe thunderstorms, thunderstorm winds, severe winter weather	Attend special training on administration and permitting under NFIP and Flood Hazard Overlay District.	ZA/FA, Select Board, Planning Commission, Regional Floodplain Manager	Medium	ACCD municipal training assistance funds, EMPG CVRPC, ANR, VLCT	1-2 years 2020-2022
Flooding/Fluvial Erosion, Severe Thunderstorms, Thunderstorm Winds	Selected projects from Mad River Corridor Plan – see appendix	Select Board, Residents, Town Administrator, Road Crew, ANR	Medium - low	ANR, Vtrans, HMGP, General Fund	2220-2024 3-4 years; as town capacity and funds allow

VEM also emphasizes a collaborative approach to achieving mitigation on the local level, by partnering with ANR, VTrans, ACCD, Regional Planning Commissions, FEMA Region 1 and other agencies, all working together to provide assistance and resources to towns interested in pursuing mitigation projects and planning initiatives.

The mitigation activities are listed in regards to local leadership, possible resources, implementation tools, and prioritization. The method used for prioritization of the actions was qualitative and based upon: 1) the Community's need to address the issue, 2) the action's cost, 3) the action's benefit, and 4) the availability of potential funding. Emphasis was placed on a review of the benefits (pros) and costs (cons) when prioritizing the mitigation actions with the expectation that the benefits would outweigh the costs.

In performing the benefit cost review, the team reviewed a wide range of questions concerning the mitigation actions. How immediate and critical is the need to the community? How costly is the action? Is it a low-cost strategy? Is the action cost effective and seem reasonable for the nature of the project? Are funds already secured or readily available? Does the action use outside funding sources? Is there a time restriction on expending funds? Can the action be budgeted in the current or upcoming budget cycle or does it require long term debt? What is the level of risk to community assets (people, economy, structures, critical facilities & infrastructure, and the natural environment)? Does the action provide for the protection of life and property and reduce the risk for loss, injury, or damage? How critical are the community assets that benefit from the action? How fast will the action take to implement? How many people and or area will benefit from the action; whole community, neighborhood, individual? What benefits will the action provide? Does the action support the community goals, polices and plans?

The following categories are used to define the priority of each mitigation action/strategy.

HIGH - A High prioritization denotes that the action is either critical or potential funding is readily available or in hand, and should have a timeframe of implementation of less than two years. These projects also use grants and other outside funding sources; provide the greatest protection from loss of life and property damage; are cost effective; have a larger benefit; and provide a higher degree of risk reduction for community assets.

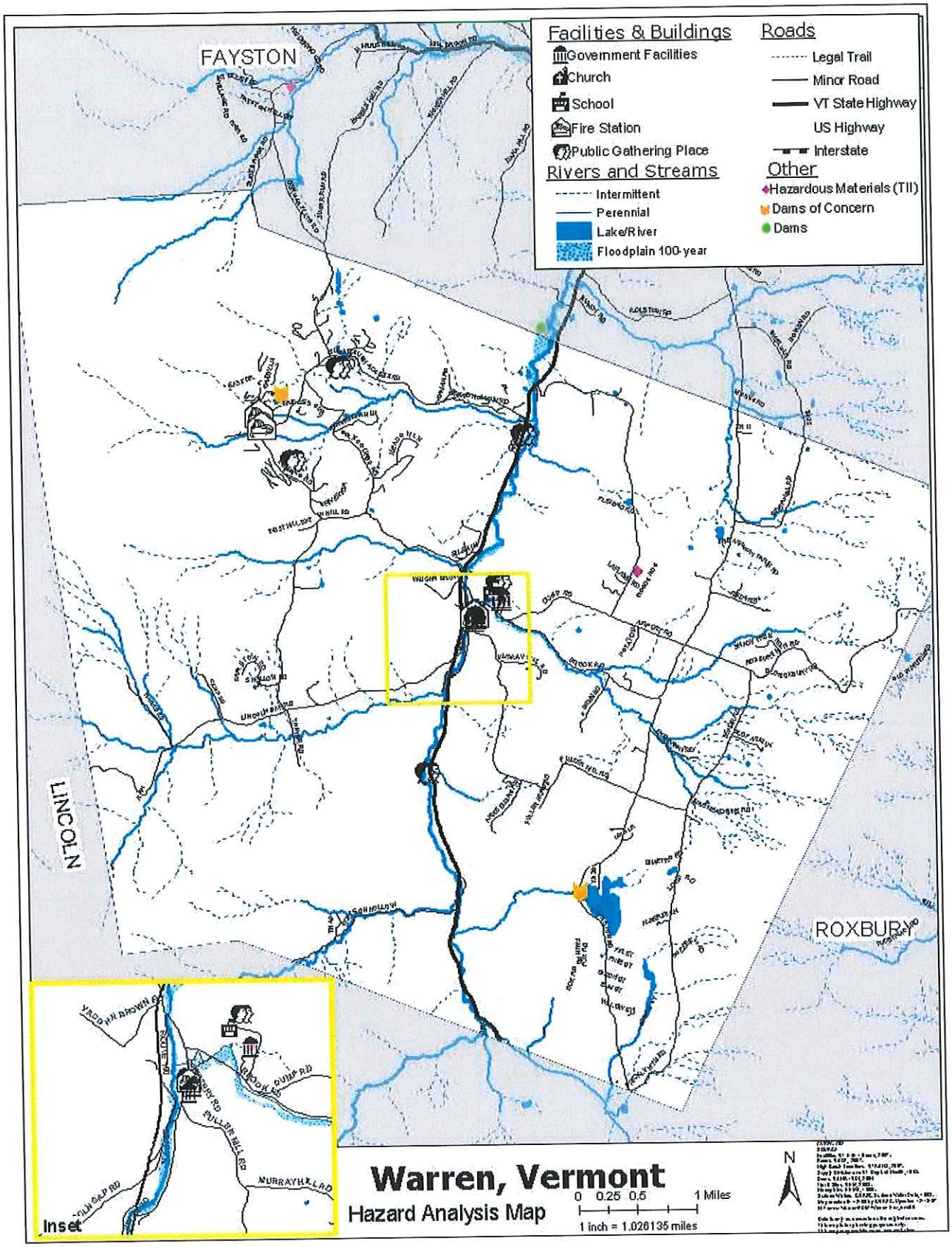
MEDIUM - A Medium prioritization is warranted where the action is less critical or the potential funding is not readily available and has a timeframe for implementation of more than two years but less than four. These projects are somewhat cost effective at reducing damage to property and people, have some benefit, and provide some degree of risk reduction for community assets.

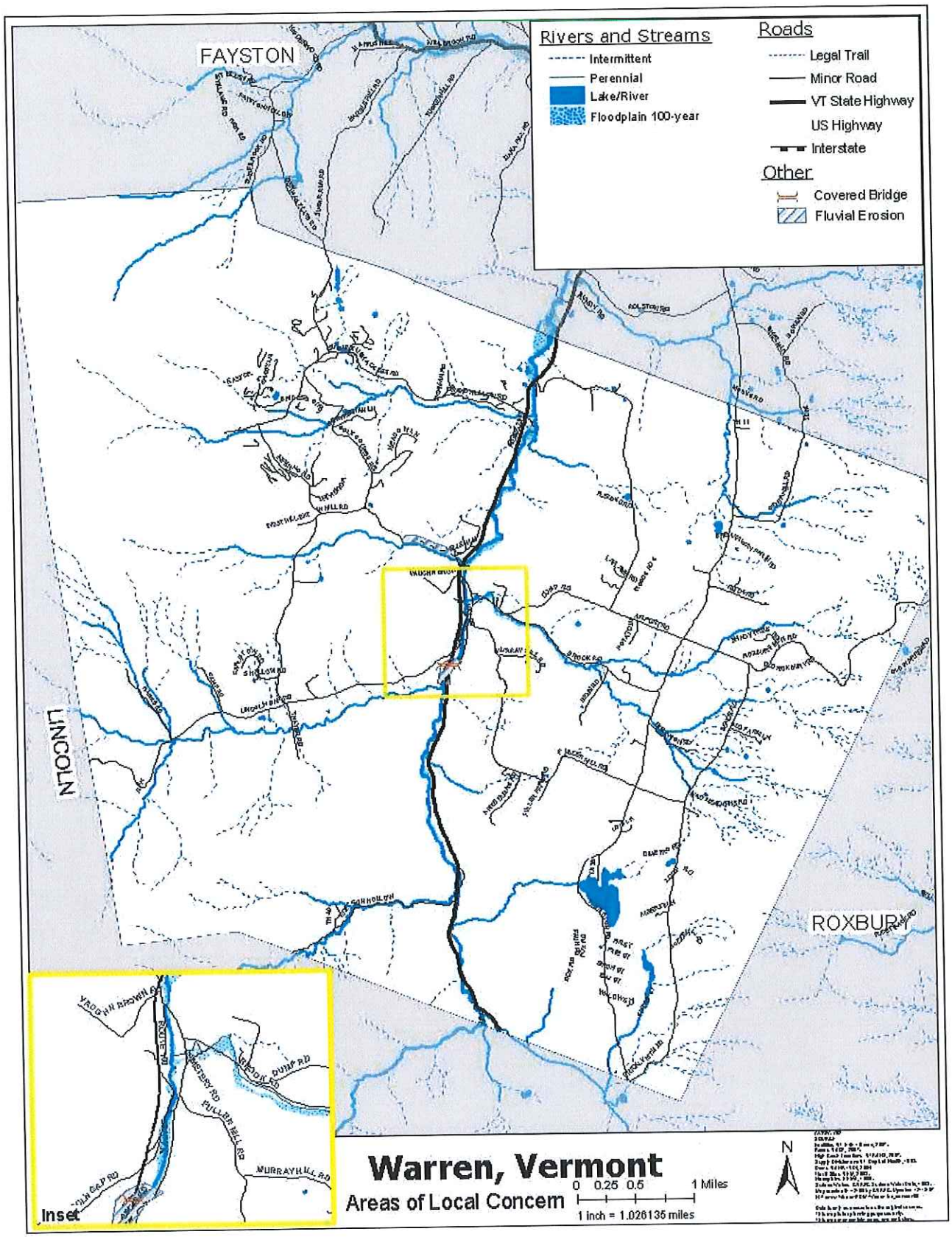
LOW - A Low prioritization indicates that the timeframe for implementation of the action, given the action's cost, availability of funding, and the community's need to address the issue, is more than four years. These actions may have limited benefit or the cost effectiveness is low. The community assets that benefit from the action are not in immediate need or are a low priority.

Warren understands that in order to apply for FEMA funding for mitigation projects that a project must meet FEMA benefit cost criteria. The Town must also have a FEMA approved Hazard Mitigation Plan as well.

Attachments

- 2018 Hazards Analysis Map
- 2013 Fluvial Erosion Overlay Map
- Flood and Erosion Hazard Area Map (figure 6 in draft 2018 Town Plan)
- Maps and Projects from the Mad River Corridor Plan
- Road Erosion Survey, Map of Road Erosion Inventory Segment Scoring
- Road Erosion Survey, Map of Road Erosion Inventory Very high priority segments.
- 5 Year Plan Review Maintenance Flow Chart
- Mitigation Tracking spreadsheet template sample
- Certificate of Adoption


Facilities & Buildings
Government Facilities
Church
School
Fire Station
Public Gathering Place
Rivers and Streams
Intermittent
Perennial
Lake/River
Floodplain 100-year
Roads
Legal Trail
Minor Road
VT State Highway
US Highway
Interstate
Other
Hazardous Materials (TII)
Dams of Concern
Dams
FAYSTON
LINCOLN
ROXBURY
Inset
Warren, Vermont
Hazard Analysis Map
0 0.25 0.5 1 Miles
1 inch = 1.026135 miles
N


Rivers and Streams
Intermittent
Perennial
Lake/River
Floodplain 100-year
Roads
Legal Trail
Minor Road
VT State Highway
US Highway
Interstate
Other
Covered Bridge
Fluvial Erosion
FAYSTON
LINCOLN
ROXBURY
Inset
Warren, Vermont
Areas of Local Concern
0 0.25 0.5 1 Miles
1 inch = 1.026135 miles
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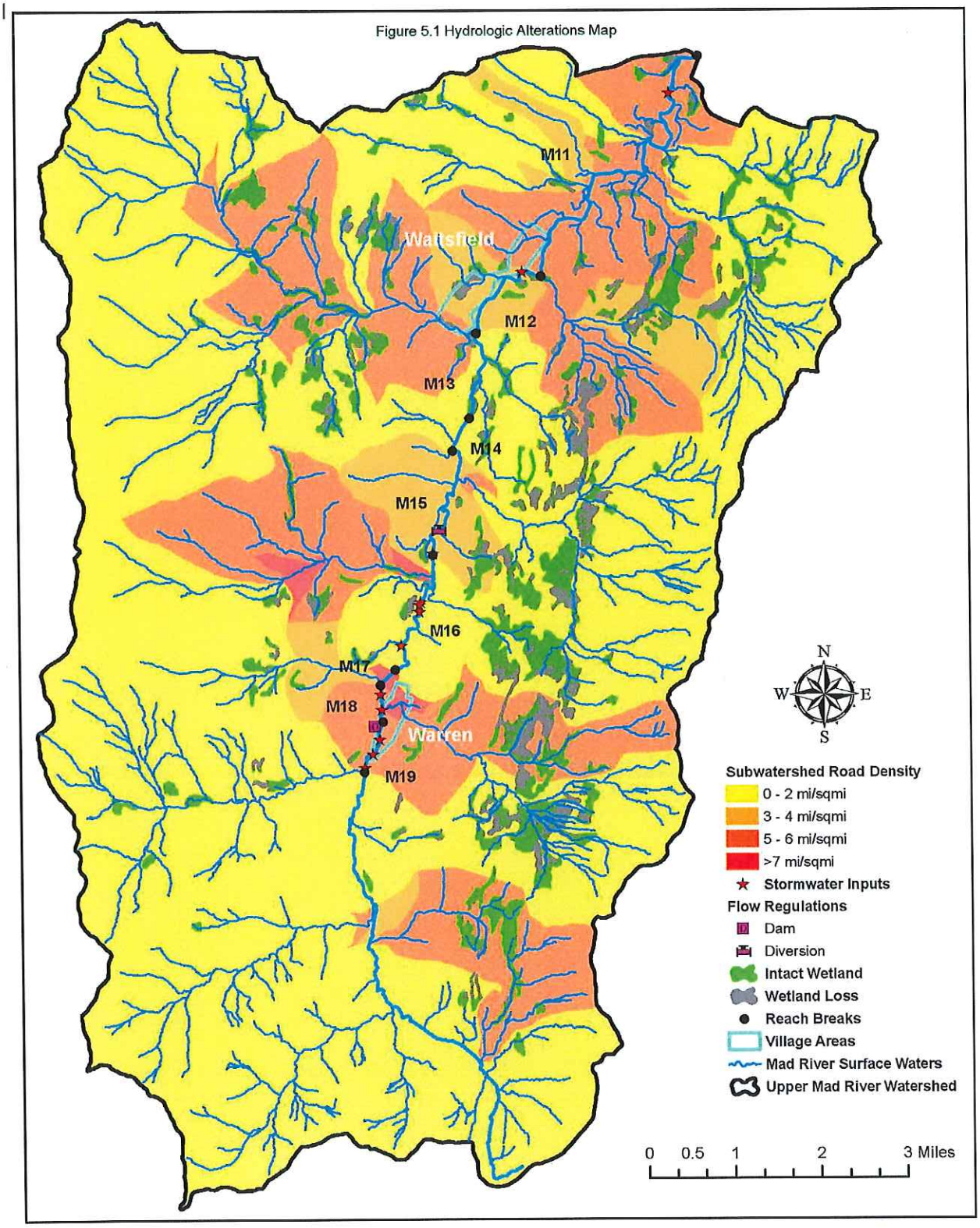


Figure 5.1 Hydrologic Alterations Map
M11
Wattsfield
M12
M13
M14
M15
M16
M17
M18
Warren
M19
N
W
E
S
Subwatershed Road Density
0 - 2 mi/sqmi
3 - 4 mi/sqmi
5 - 6 mi/sqmi
>7 mi/sqmi
Stormwater Inputs
Flow Regulations
Dam
Diversion
Intact Wetland
Wetland Loss
Reach Breaks
Village Areas
Mad River Surface Waters
Upper Mad River Watershed
0 0.5 1 2 3 Miles

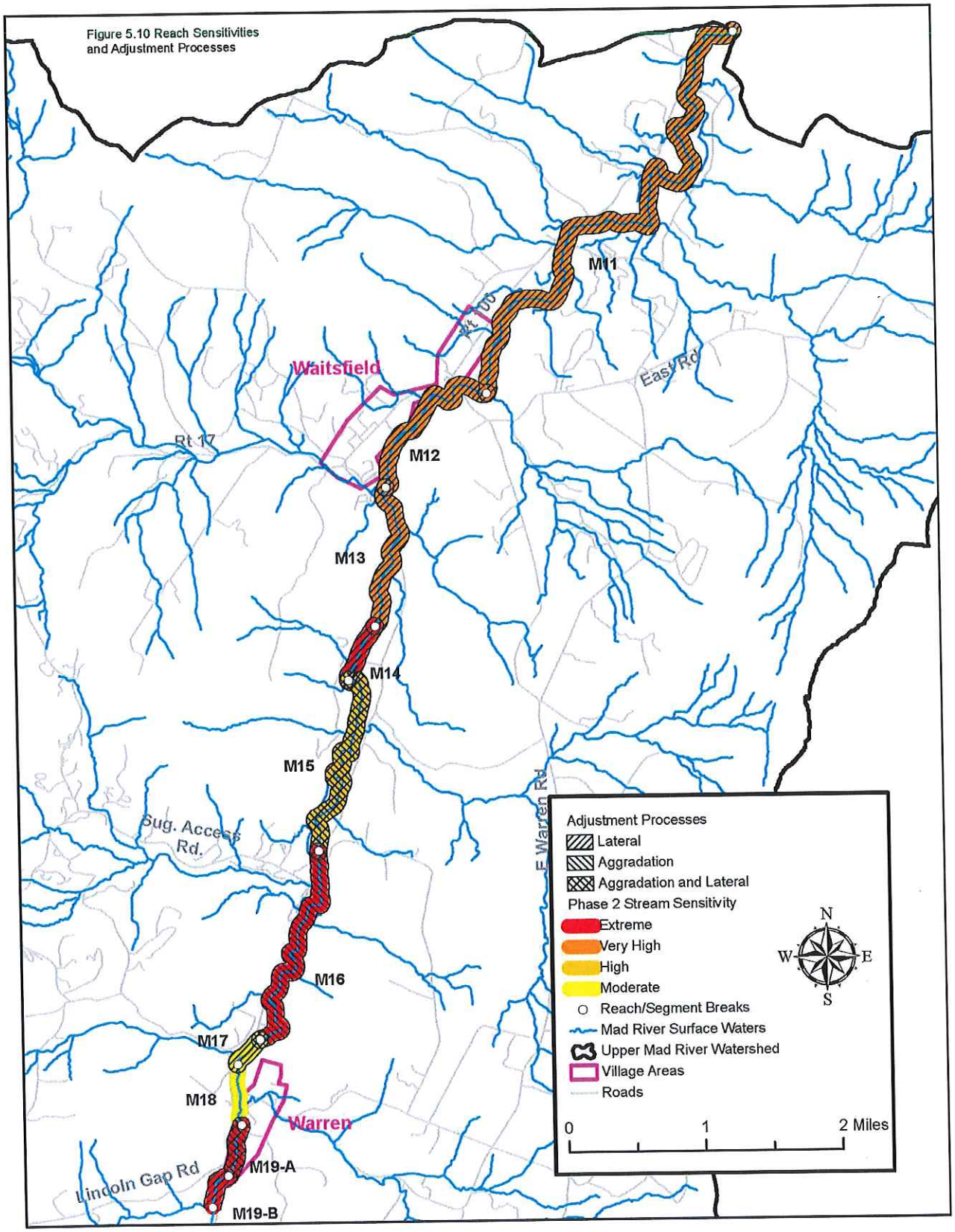


Figure 5.10 Reach Sensitivities and Adjustment Processes
M11
M12
M13
M14
M15
M16
M17
M18
M19-A
M19-B
Waitsfield
Warren
Rt 17
East Rd
E Warren Rd
Sug. Access Rd.
Lincoln Gap Rd
Adjustment Processes
Lateral
Aggradation
Aggradation and Lateral
Phase 2 Stream Sensitivity
Extreme
Very High
High
Moderate
Reach/Segment Breaks
Mad River Surface Waters
Upper Mad River Watershed
Village Areas
Roads
N
W
E
S
0
1
2 Miles

Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
		snowmaking pond to reduce pressure and chance of avulsion into the pond. Possibly gain/recreate some floodplain on the right bank adjacent to the snowmaking pond and/or on the left bank just downstream of the Rt 100 bridge.				
M15-4	Warren Trestle Bridge has sediment deposition upstream, stepped footers and deteriorating abutments.	Replace structure with an appropriately sized bridge.	The Town of Warren and VTRANS have been working to find a larger trestle bridge and have apparently located one.	Keeping the trestle style will preserve that icon of the valley.	David Hoyne at VTRANS, Town of Warren	None, bridge already exists.
M16-1 C-F departure III Fair Fair	Channel experienced a stream type departure of C to F (incision 2.1, entrenchment 1.2) and has lost floodplain access. Altered by channel straightening and bank armoring, and constriction from Rt. 100, increasing stream power. Some riprap being undermined. Area upstream of Riverside Park is heavily armored on left bank.	Protect corridor in the vicinity of Riverside Park to allow for channel adjustment and sediment attenuation. Depositional reach currently has limited sediment attenuation areas, which exacerbates sediment deposition problems in downstream reach at Snowmaking Pond.	Feasibility depends on willingness of landowners to cooperate. High priority as this is one of the few areas until M15 where sediment attenuation is possible.	Improved biotic habitat and reduced sediment loading of Mad River watershed to Winooski and Champlain Basins. Reduced risk of future structural damage.	Town of Warren, RMP, MRCP. Cost of corridor acquisition or easement acquisition. Or dev. & mgmt. rights	Limit structural development of Riverside park.
M16-2 C-F departure	Channel experienced a departure of C to F (incision 2.1, entrenchment 1.2) and	Protect corridor in the upper reach to allow for channel adjustment and sediment	Feasibility depends on willingness of landowners to	Improved biotic habitat and reduced sediment	RMP, MRCP. Cost of corridor acquisition or	Convert low-intensity agricultural

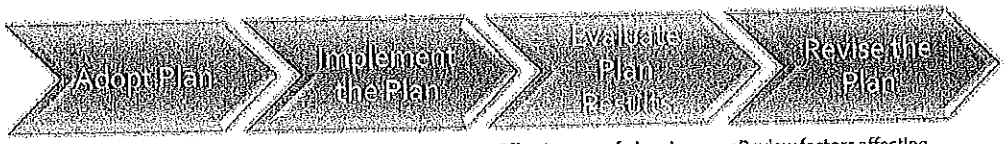
Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
III Fair Fair	has lost floodplain access. Armoring in upper reach along Rodger's parcel.	attenuation. Remove bank armoring on left bank where future meanders will not impact Route 100.	cooperate. High priority because attenuation areas are limited in reach.	loading of Mad River watershed to Winooski and Champlain Basins.	easement acquisition. Or dev. & mgmt. rights	lands to forest.
M16-3 C-F departure III Fair Fair	Channel experienced a departure of C to F (incision 2.1, entrenchment 1.2) and has lost floodplain access. Altered by channel straightening and bank armoring, and constriction from Rt 100, increasing stream power. Some riprap being undermined.	In areas without building and road constraints, restore incised section of reach through "active" restoration of bed forms and/or floodplain features in equilibrium with channel bed elevation and increased stream power. Protect the stream corridor and plant buffer vegetation in conjunction with restoration projects.	Medium – high priority as there is no recently abandoned floodplain, but there are some potential areas where floodplain could be lowered. Appears to have been depositional reach in past.	Improved biotic habitat and reduced sediment loading of Mad River watershed to Winooski and Champlain Basins.	RMP Relatively high to excavate new floodplain. Additional costs in corridor easements/ acquisition & plantings	Convert low-intensity agricultural lands to forest.
M17-1 B to F departure IV Fair Good	Reach is in a bedrock gorge with some aggradation observed. Wooded buffer is greater than 100 feet. 50 Feet of riprap was on the left bank at the Bradley Brook confluence.	Protect stream corridor to prevent encroachment and buffer clearing.	Low priority for corridor protection due to the wooded corridor and unlikely encroachment pressure.	Maintained buffer for input of LWD and shading for biotic habitat.	RMP, MRCP Cost of corridor acquisition or easement acquisition.	Largely forested corridor.
M18-1 Ba I Fair Good	Reach in a rock gorge downstream of the Warren Crib Dam and confined by bedrock banks. Channel adjustment is unlikely due to bedrock. Some of the	Protect the woody vegetation in the corridor to prevent further clearing. Possibly plant buffer in area just downstream of M19 reach break.	Low-Medium priority for protection because current encroachment has not impacted channel stability (due to bedrock controls).	Preserves wooded setting of the village. Maintained buffer for input of LWD and	Town of Warren. Low cost to implement policy.	Residential, Warren Village. No "conversion" would be needed - only

Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
	Warren Village development encroaches into the corridor.			shading for biotic habitat.		new develop. limited.
M19A-1 C-F departure III Fair Fair	Stream corridor included residential development, roads, and low buffer width. A departure from C to F had occurred and the channel lacks floodplain access (incision 2.01). May have been a B type before the crib dam.	Adopt a no filling or cutting in the stream corridor policy to prevent further encroachments.	High feasibility. High priority due to current level of fill and development.	Maintained buffer for input of LWD and shading for biotic habitat. Reduced property damage.	Town of Warren. Low cost to implement policy.	Residential, Warren Village. No "conversion" would be needed - only new develop. limited.
M19A-2 C-F departure III Fair Fair	This segment has been straightened and partially armored and is influenced by sedimentation upstream of the Crib Dam. Channel is aggrading and attempting to widen but hindered by riprap application.	Remove Crib Dam. Investigate whether allowing some of the coarse gravel sediment to move downstream would cause negative impacts to infrastructure or channel adjustments downstream.	High priority due to the structure being non-essential. Recommended to be done in conjunction with corridor protection of sediment attenuation areas downstream (i.e., reach M16).	Improved biotic habitat and fish migration. Reduced flood/erosion risks. Improvement of incision in downstream reaches (M16)	High cost, especially if sediment needs to be removed. Town of Warren, RMP, USCOE	Possibly controversial due to age of dam/historical nature. Some residential properties and lawns may be reconfigured for new channel dimensions.
M19A-3	Covered Bridge north of Warren Village. Channel is aggrading and attempting to widen but hindered by riprap application.	Replace covered bridge or widen the bridge footings to accommodate the equilibrium channel width.	High priority if crib dam removed due to bed changes and potential increased adjustments.	Improved biotic habitat. Reduced flood/erosion risks. Improvement of incision in downstream reaches (M16)	VTAOT, Town of Warren	Possibly controversial due to historic significance of bridge. No major land use conversion required.

Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
M19A-4	Stream corridor included residential development, roads, and low buffer width. Project area is upper segment from bedrock controls down to riprap on left bank - length approx. 500 feet.	High priority corridor protection in upper segment. Prevent further structural development and plant woody buffer.	Difficult due to numerous small parcels and existing encroachments.	Improved biotic habitat. Reduced flood/erosion risks.	Low - cost of plant materials and volunteers. Town of Warren, RMP, FMR, Landowners	Some lawns and yards would be converted to woody buffer.
M19B-1 C-F departure III Fair Fair	Upstream of Rt 100 - Channel is overwidened and confined by Route 100. The channel is incised (IR=2.8) and has riprap preventing bank erosion and transferring power downstream. Two bedrock ledges control the grade at the downstream end.	Restore the incised reach through protecting the corridor on the left bank if possible and recreate some floodplain on the left bank, either through floodplain lowering or installation of sediment trapping grade control structures to attenuate flow and sediment.	Medium high priority as constraints and constrictions exist with limited options from this area downstream past the snowmaking pond. This is the last area before Warren Village to reduce velocities or attenuate some sediment.	Improved biotic habitat. Reduced flood/erosion risks.	High cost to lower floodplain. RMP	Current Bobbin mill and access road would likely require relocation, unless benefits can be gained from the small terrace areas downstream on left bank
M19B-2	The Rt 100 bridge at the downstream end has a wide span at the roadbed, however large amounts of riprap fill the channel and floodplain sides in a trapezoid shape.	Widen rip rapped banks to reduce flood flow constriction and sediment discontinuity.	Requires coordinating with VTRANS. Moderate costs associated with rock removal.	Reduced erosion pressure on banks upstream of bridge.	VTRANS, VTAOT. Cost of Equipment and stabilization materials.	Not significant.

Abbreviations:
RB/LB: Right Bank/Left Bank (facing downstream)
MF: Mass Failure

5-Year Plan Review/Maintenance



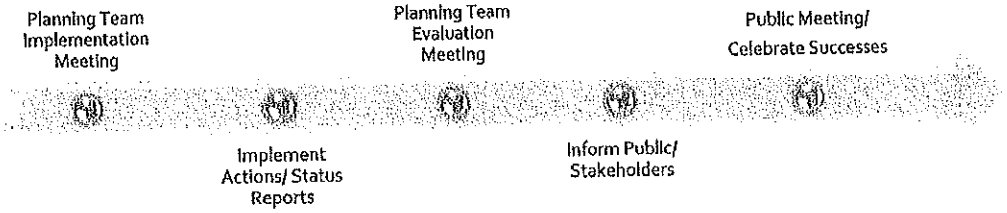
- Brief local leadership on plan approval
- Formally adopt plan
- Publicize plan approval and adoption
- Celebrate success

- Confirm/clarify responsibilities
- Integrate mitigaction actions
- Monitor and document implentation of projects and actions
- Establish indicators of effectiveness or success

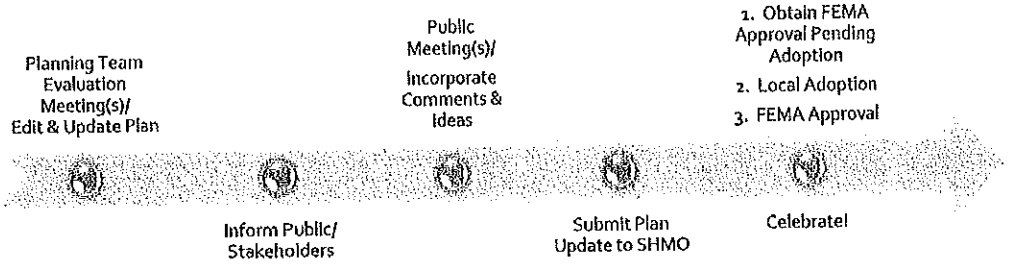
- Effectiveness of planning process
- Effectiveness of actions
- Document success & challenges of actions
- Update and involve community
- Celebrate successes

- Review factors affecting community's context
- Analyze findings; determine whether to revise process or strategy
- Incorporate findings into the plan

After Plan Adoption-Annually
Implement and Evaluate



Fifth Year, and After Major Disaster
Evaluate and Revise



Mitigation Action Evaluation Table

Use this worksheet to help evaluate and prioritize each mitigation action being considered by the planning team. For each action, evaluate the potential benefits and/or likelihood of successful implementation for the criteria defined below.

Rank each of the criteria with a -1, 0 or 1 using the following scale:

1 = Highly effective or feasible
0 = Neutral
-1 = Ineffective or not feasible

Mitigation Strategy	Effectiveness	Technically Feasible	Business Impacts	Political	Cost	Funding Resource Available	Administrative Capacity	Community Capacity	Outside Assistance Available?	Regulatory & other restrictions	Total Score

Developed by Northeastern Vermont Development Association from the FEMA Mitigation Action Evaluation Worksheet (Appendix A-3.1) provided in the FEMA Local Mitigation Planning Handbook March 2013. G. Aloisio